Investigating Self-Regulated Learning in Massive Open Online Courses: A Design Science Research Approach

by

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Thesis

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Contents

List of Tables

List of Figures

Acknowledgments

This research work was conducted in the Department of Computer Science, using formerly existing course content design for teachers of computer science. The course was restructured, and a blended classroom including a computer security seminar was introduced. I am grateful to my supervisor, Associate Professor Dr Jane Sinclair, for giving me the opportunity to pursue my doctoral studies, aiding me towards achieving my research interest, and supporting me in channelling my research focus in educational learning technology. I am also grateful to Associate Professor (and reader) Dr Mike Joy, who has supported my research ethical approval document, and as my adviser. My thanks go to Associate Professor Dr Maria Liakata, who supported me as my co-adviser, for her contribution on how to measure my research questions. I consider myself lucky to be supported by these great academics with a wealth of knowledge and guidance throughout my research annual reports. I also appreciate the support from my fellow PhD colleagues in the department and the colleagues from the School of Education for their advice during my eLDa pilot study. I will like to thank especially Miss Elaine Pang from the Centre for Education Studies (CES) at Warwick University for her tireless support and engagement with my eLDa course, for proofreading my chapters, and for giving me constructive feedback. I am grateful to Dr Russell Bayott and Dr Jonathan Foss for their support at the initial stages of my research. The various meetings held with both were of great importance to model my research questions and focus. I would like to convey my thanks to both for their support in giving me access to the existing platform to under-study and write my very first initial paper from the gap identified in my research using data extracted from the computing for teachers MOOC.

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Finally, *'How can I repay the Lord for all His goodness to me?'*. I give glory to God Almighty for all the support and help that He gave me and all the blessings I received during my Doctorate programme. May God be praised, worshipped and adored forever and ever. Amen

Dedication

This thesis is dedicated in loving memory of all my family members who have passed away during my studies; My Mother Mrs Paulina Onah, my elder sister Miss Mary Onah, my younger sister Miss Juliana Onah. May their souls rest in perfect peace. Amen. Eternal rest, grant unto them, O Lord, and let perpetual light shine upon them. May they rest in peace. Amen

This thesis is also dedicated to the rest of my family members, my Dad Retired Warrant Officer (WO) Paul Onah, who raised and cared for us all. My elder brother Mr Adakole Onah who has supported me financially during my studies, My younger siblings; Mrs Maria Uloko, Mr John Onah, Mrs Agness Neol Empraw , Miss Elizabeth Onah and also my in-laws, nephews, nieces and cousins for all their prayers and patience during my studies. Today, I believed, I have made you all proud.

Declarations

This Thesis is submitted to the University of Warwick in support of my application for the conferment of the degree of Doctor of Philosophy. I hereby declare that, this thesis has been written by myself, except where otherwise acknowledged, and has not been submitted elsewhere for the purpose of academic degree.

Daniel Friday Owoichoche Onah

Signature:____________________________________

Date:____

Publications

This thesis consists of an overview of the following research publications, which made up some of the chapters of this document.

Book Chapter

1. Onah, D. F. O. and Sinclair, J. E.. 2017. A Multi-dimensional Investigation of Self-regulated Learning in a Blended Classroom Context : A Case Study on eLDa MOOC. In, M.E. Auer et al. (eds.), Interactive Collaborative Learning, Advances in Intelligent Systems and Computing, pp. 63-85, 545, Springer International Publishing AG.

Journal Publications

2. Onah, D. F. O., Sinclair, J. E. (2017) Assessing Self-Regulation of Learning Dimensions in a Stand-alone MOOC Platform. International Journal of Engineering Pedagogy (IJEP).(Accepted for publication in May 2017).

3. Onah, D. F.O., Sinclair, J.E., Boyatt, R. (2015) Forum Posting Habits and Attainment in a Dual-Mode MOOC. International Journal for Cross-Disciplinary Subjects in Education (IJCDSE), Special Issue Volume 6, Issue 1, ISSN 2042 6364 (Online)

Conference Publications

4. Onah, D. F.O. and Sinclair, J.E. (2016) A Multi-Dimensional Investigation of Self-Regulated Learning in a Blended Classroom Context: A Case Study on eLDa MOOC. In the 19th International Conference on Interactive Collaborative Learning(ICL2016), Belfast, United Kingdom. 21st- 23rd September, 2016.

5. D.F.O. Onah, J.E. Sinclair (2016) Exploring Learners' Strategies of Self-Regulated Learning Abilities in a Novel MOOC Platform: eLDa. 23^{rd} Annual Conference of the Association for Learning Technology (ALT2016). University of Warwick, United Kingdom. 6^{th} -8^{th} September, 2016.

6. Onah, D. F.O. and Sinclair, J.E. (2016) An Empirical Investigation of students' perceptions of self-regulated learning in Online Blended Learning: A case study of a Novel E-Learning Platform. In Proceedings of the 8^{th} International Conference on Education and New Learning Technologies (EDULEARN16), pp.5960 - 5969. Barcelona, Spain. 4^{th}-6^{th} July, 2016.

7. Onah, D. F.O., Sinclair, J.E., Pang, E.L.L. and Jantjies, M. (2016) Exploring the multi-dimensional attainment of self-regulatory learning skills in educational contexts: A comparative study. In Proceedings of the 8^{th} International Conference on Education and New Learning Technologies (EDULEARN16), pp.5970 - 5979. Barcelona, Spain. 4^{th}-6^{th} July, 2016.

8. Onah, D.F.O. and Sinclair, J.E. (2016). Design Science MOOC: A Framework of Good Practice Pedagogy in a Novel E-Learning Platform eLDa. In Proceedings of the 28^{th} EdMedia: World Conference on Educational Media and Technology (EDMEDIA2016), (pp. 511-518). Association for the Advancement of Computing in Education (AACE).Vancouver, British Columbia, Canada: June 28^{th}- 30^{th}, 2016.

9. Onah, D. F. O. and Sinclair, Jane (2015) Measuring self-regulated learning in a novel e-learning platform: eLDa. In: Koli Calling : International Conference on Computing Education Research, Koli, Finland, 19^{th}-22^{nd} Nov 2015. Published in: Proceedings of the 15^{th} Koli Calling International Conference on Computing Education Research. Pages 167 - 168. ACM New York, NY, USA, ISBN : 978-1-4503-4020-5.

10. D.F.O. Onah, J.E. Sinclair (2015) Learning as a Perspective of Reflective Practice in Computer Science. 22^{nd} Annual Conference of the Association for Learning Technology (ALT2015). University of Manchester, United Kingdom. 8^{th} 10^{th} September, 2015.

11. D.F.O. Onah, J.E. Sinclair (2015) Learners Expectations and Motivations using Content Analysis in a MOOC. In the Proceedings of 27^{th} Annual World Conference on Educational Media and Technology (ED-MEDIA2015) ,(pp. 1403-1412). Association for the Advancement of Computing in Education (AACE). Montreal, Quebec, Canada. 22^{nd} 24^{th} of June, 2015.

12. D.F.O. Onah, J.E. Sinclair (2015) Massive Open Online Courses: An Adaptive Learning Framework, In Proceeding of the 9^{th} International Technology, Education and Development Conference (INTED2015), pp. 1258-1266.Madrid, Spain. 2^{nd}-4^{th} of March, 2015.

13. D.F.O. Onah, J.E. Sinclair (2015) Collaborative Filtering Recommendation System: A Framework in Massive Open Online Courses, In Proceeding of the 9^{th} International Technology, Education and Development Conference (INTED2015), pp. 1249-1257.Madrid, Spain. 2^{nd}-4^{th} of March, 2015.

14. Onah, D. F.O., Sinclair, J.E., Boyatt, R., Foss, J. (2014) Massive Open Online Courses : Learner Participation. In Proceeding of the 7^{th} International Conference of Education, Research and Innovation (iCERi2014), Seville, Spain. 17^{th}- 19^{th} November, 2014.

15. Onah, D. F.O., Sinclair, J.E., Boyatt, R. (2014) Exploring the Use of MOOC Discussion Forums. London International Conference on Education (LICE-2014) . London, United Kingdom. 10^{th}- 12^{th} November, 2014.

16. Onah, D. F.O., Sinclair, J., Boyatt, R. (2014) Dropout Rates of Massive Open Online Courses : Behavioural Patterns. In Proceedings of the 6^{th} International Conference on Education and New Learning Technologies (EDULEARN14), Barcelona, Spain. 7^{th}-9^{th} July, 2014.

Author's Contributions

The following presents the author's contributions in a book chapter, journal and conference publications. These publications were written by myself, my supervisor and co-authors for selected publications.

Publication 1 : A Multi-Dimensional Investigation of Self-Regulated Learning in a Blended Classroom Context : A Case Study on eLDa MOOC

This book chapter presents self-regulated learning habits of blended-learning students. The findings revealed the different learning habits of the students and how they preferred to study. The findings of this study also shows that using existing instrument as applied in one study might not be applicable with others.

Publication 2 : Assessing Self-Regulation of Learning Dimensions in a Stand-alone MOOC Platform

This journal paper investigates self-regulated learning (SRL) in relation to massive open online courses (MOOCs) and appropriate strategies to foster SRL skills in a stand-alone MOOC learners. This study reports an investigation and assessment of the concept of SRL using a novel MOOC platform (eLDa) by providing study options (either via a self-directed learning or instructor-led learning path) using a novel learning tool. In view of this, the research presents general description of self-regulated learning and explored the various existing dimensions used to expose the learners SRL skills.

Publication 3 : Forum Posting Habits and Attainment in a Dual-Mode MOOC

This journal paper was an extension of a conference paper on 'exploring the use of MOOC discussion forums'. The journal examines issues relating to forums through a brief literature review and by drawing on data from a specific MOOC run by the University of Warwick. We analysed two groups of users; those who contributed to forums and those who did not, using comparison of their final average grades in quizzes to analyse their performance rate. It was observed in our analyses that participants in the forum performed better within the top grades at the end of the course.

Publication 4: Exploring Learners' Strategies of Self-Regulated Learning Abilities in a Novel MOOC Platform: eLDa

This paper presents general description of self-regulated learning and explores existing dimensions that could help to measure learners' SRL skills.

Publication 5: An Empirical Investigation of Students' Perceptions of Self-Regulated Learning in Online Blended Learning: A Case Study of a Novel E-Learning Platform

The main aim of this paper was to investigate the usefulness of blended-learning used in teaching first year undergraduate students. It also explores the various techniques used by students in order to motivate themselves and enhance their learning habits.

Publication 6: Exploring the Multi-Dimensional Attainment of Self-Regulatory Learning Skills in Educational Contexts: A Comparative Study

This paper investigates the self-regulatory learning skills from two different dimensional student perspectives. The comparison was conducted between students from a developed nation and students from a developing nation.

Publication 7: Design Science MOOC: A Framework of Good Practice Pedagogy in a Novel E-Learning Platform eLDa

The main purpose of this paper was to apply design science research methodology (DSRM) to develop an e-learning tool which incorporates good pedagogical practice needed for supporting different learners' expectations and provided suitable learning resources to aid individual learners in their choice of studies.

Publication 8: Measuring Self-Regulated Learning in a Novel E-Learning Platform: eLDa

This research introduces a novel MOOC learning platform known as 'eLDa', which implements a new approach to the MOOC structure and incorporates several theory-based features specifically aimed at addressing problems associated with high attrition. In particular, the framework supports users in establishing their own learning objectives and establishing individual learning paths. We seek to investigate the relationships between learner choice, learner engagement, and development of capacity for self-regulated learning. Our approach allows 'success' to be defined not in terms of full completion of a course, but whether learners achieve their objectives.

Publication 9: Learning as a Perspective of Reflective Practice in Computer Science

The main goal of this research is to describe the various methods applied in teaching undergraduate students during seminars and lab demonstrations in a Computer Security module. The students feedback was extracted from the data collected using a survey. The data was then analysed using statistical package for the social sciences (SPSS). The analysis reveals the level of acceptance of the various methods applied during teaching.

Publication 10: Learners Expectations and Motivations using Content Analysis in a MOOC

This paper describes the expectations of learners and how learners could be motivated to participate consistently in a MOOC. The research discusses preliminary findings on the expectations of learners, and motivation of learners measured using a qualitative content analysis which was analysed using statistical package for the social sciences (SPSS). The learners' expectations were classified into four categories according to their related themes.

Publication 11: Massive Open Online Courses: An Adaptive Learning Framework

The main aim of this research is to create a framework from which we based our final eLDa system prototype. The framework supports users in creating their own paths of learning, and allowing them to make informed choices about appropriate resources based on their preferences.

Publication 12: Collaborative Filtering Recommendation System: A Framework in Massive Open Online Courses

This research focuses on collaborative filtering method (CFM) of content recommendation. CFM is the process of evaluating several items through the rating choices of the participants. We wanted to investigate the support of the recommendation system in an online study, and how it supports learning and encourages more effective participation. The main aim was to recommend courses to different users in a text editor mode using a recommender algorithm developed in Python programming.

Publication 13: Massive Open Online Courses: Learners Participation

This paper provides a brief qualitative assessment of two different MOOC approaches focusing on particular data related to learner participation in forums and quizzes. The two approaches investigated are; firstly, a comprehensive report from the University of Edinburgh (using previously published data drawn from 6 courses), and secondly from the University of Warwick (presenting new data from computing for teachers MOOCs).

Publication 14: Exploring the Use of MOOC Discussion Forums

This paper discusses forums in massive open online courses (MOOCs) as a primary means of interaction among learners and the instructor. The paper revealed that despite their widespread use, there is a concern that forums are not an effective means of promoting engagement and learning. The results indicated that forum use overall is low and that tutor-moderation may affect the effectiveness in discussion, and while peer-to-peer support forums fail to offer adequate support. This paper is further extended into a journal on 'Forum Posting Habits and Attainment in a Dual-Mode MOOC'.

Publication 15: Dropout Rates of Massive Open Online Courses: Behavioural Patterns

This paper investigates MOOC attrition from several different perspectives. We review existing literature relating to MOOC dropout rates, bringing together existing findings on completion rates and analyses of several specific courses, which identify factors that correlate to likelihood of dropout. We provide a meta-analysis of the basic figures on overall dropout rates previously collected to identify relationships between course factors and dropout rates. In addition, the literature is reviewed from a qualitative perspective drawing together findings on the reasons for dropout and methods suggested for resolving or reducing the dropout rate. Using themes emerging from the initial investigation, we provided a preliminary analysis of data gathered from a Computing MOOC ran by the University of Warwick, UK using a Moodle platform. Different aspects of students' demographic data are examined to see if relationships to persistence exist.

Abstract

Massive open online courses (MOOCs) have received wide publicity and many institutions have invested considerable effort in developing, promoting and delivering such courses. However, there are still many unresolved questions relating to MOOCs and their effectiveness. One of the major recurring issues raised in both academic literature and the popular press is the consistently high dropout rate of MOOC learners. Despite the impressive levels of enrolment MOOCs attract, many participants do not complete these courses resulting in completion rates of below 15% for most MOOCs. Although there are many reasons for attrition, a lack of understanding of how diverse learners can be supported to study effectively within this format has been identified as an important contributing issue. The current research addresses two factors which relate to how MOOC participants learn and their ability to make effective progress. Firstly, MOOCs require a high degree of self-regulated learning (SRL) skills but most do not appear to offer adequate support for the development of such skills. To determine the implications of this and develop appropriate support strategies it is necessary to understand more about the concept of SRL in the context of MOOCs and MOOC participants. Related to the issue of self-regulation is the inflexibility and passivity of many current MOOC formats, preventing individuals from setting their own learning objectives and directing their own learning.

MOOCs have so far been used mainly to provide stand-alone distance learning opportunities for independent learners. However, there is an increasing focus on their benefits when incorporated into a blended-learning approach. This study

investigates the issues of self-regulation and learner autonomy within MOOCs. To better understand the contextual differences between the two very different learning modes, the research considers two separate MOOC applications: one stand-alone, the other blended. Both qualitative and quantitative data collection methods were used to explore learners' SRL skills, autonomous choices and ways of working. An existing conceptualisation of SRL incorporating six separate contributing dimensions was adopted as the theoretical framework for the investigation.

Overall, a design science methodology was adopted. Central to this was the development of a novel MOOC platform (eLDa) which was designed to support learners' individual choices relating to goal-setting and the selection of learning path. Elements of established good-practice for MOOC platforms were incorporated into the design together with additional functionality to support the novel features of optional self-direction. In order to study the two contexts noted above, two separate courses were implemented and delivered using this platform. The first was an open online course for independent learners regardless of location; the second was incorporated as part of a blended-learning approach within a traditional campus university module. Data gathered from these courses provide insights into learners' self-regulation within the two contexts individually and also allow a comparative analysis of the different dimensions of SRL between differing teaching modalities. Qualitative data from students also contribute to an understanding of their experience of MOOC study and of how they regulate their learning in practice.

The first major contribution of this work is an architecture for and the development of a novel MOOC platform which can be used to provide the necessary functionalities to a greater degree of supporting learners' self-direction. Analysis of the data obtained from the two case studies shows different patterns of SRL. The online course results indicate that there is a high demand for more flexible, self-directed learning but that MOOC learners exhibit deficiencies in specific SRL dimensions. Help seeking and deploying task strategies were indicated as being problematic for the fully online learners. Participants in the blended-learning course generally had lower scores on time management and self-evaluation. Although there were consider-

able differences between individual students, even learners with a strong formal educational background and an existing track-record of successful learning mostly did not obtain high SRL scores. A high level of social interaction and support-seeking from peers was reported, indicating the increasing importance of social online learning even within a campus university. Analysis of the qualitative data reveals study practices which are obviously highly effective for the learners who employ them but which do not necessarily fall within existing conceptualisations of SRL.

This study demonstrates that the novel approach taken to supporting self-direction within MOOCs is one which users evaluate as being both desirable and useful. Further, it points to areas of SRL for which MOOCs should in general develop better support, while at the same time indicating strategies for SRL which are not accommodated within current definitions. This work lends support to the view that SRL is highly context-dependent and suggests that further investigation is needed to capture more appropriate conceptualisations of SRL for online and blended-learning with MOOCs.

Abbreviations

A	Agree
CAS	Computing At School
CFM	Collaborative Filtering Method
CMS	Content Management System
cMOOC	Connectivist Massive Open Online Course
CPanel	Control Panel
CSS	Cascading Style Sheets
D	Disagree
DAC	Discretionary Access Control
DBMS	Database Management System
DSR	Design Science Research
DSRM	Design Science Research Methodology
GPA	Grade Point Average
HTML	HyperText Markup Language
HTTP	Hypertext Transfer Protocol
IP	Internet Protocol

LMS	Learning Management Systems
MAC	Mandatory Access Control
MAC OS	Macintosh Operating System
MAMP	Mac OS X Apache MySQL PHP
MOODLE	Modular Object Oriented Dynamic Learning Environment
MOOC	Massive Open Online Course
MOSLQ	MOOC Online Self-Regulated Learning Questionnaire
MSLQ	Motivated Strategies for Learning Questionnaire
MySQL	My Structure Query Language
N	Neither Agree Nor Disagree
OER	Open Educational Resources
OLDS	Open Learning Design Studio
OSLQ	Online Self-Regulated Learning Questionnaire
PHP	Hypertext Preprocessor
RDBMS	Relational Database Management System
SA	Strongly Agree
SD	Strongly Disagree
SDL	Self-Directed Learning
SPSS	Statistical Package for the Social Sciences
SRL	Self-Regulated Learning
SRLI	Self-Regulated Learning Inventory

STEM	Science, Technology, Engineering and Mathematics
TB	Terabyte
TEL	Technology-Enhanced Learning
XML	Extensible Markup Language
xMOOC	eXtended Massive Open Online Course

Chapter 1

Introduction

This chapter states the problem that motivates the research and presents the research questions that provide the basis for the work. A plan of the thesis is also presented, and a brief outline is given for each of the following chapters of the thesis.

1.1 Background

Massive open online courses (MOOCs) are a rapidly growing educational phenomenon widely credited with the potential to change the face of higher education [258, 169, 168]. The term MOOC refers to an online course that is open for everyone to enrol in and can support many registered participants [184]. Moreover, MOOCs offer free online courses covering a growing range of topics, many of which are delivered by professors and lecturers from elite universities around the world [258]. The MOOC's aim is to provide online education to anyone at anytime and anywhere in the world with access to the Internet. Figure 1.1 illustrates the key characteristics of MOOCs.

Since 2012 (sometimes referred to as 'The year of the MOOC'), the provision of and participation in MOOCs have both expanded rapidly worldwide and such courses have been highly publicised [228]. However, many people who register do not go on to complete the course, leading to the issue of the high dropout rates that are widely reported in research papers and the media. Alarmingly low completion rates have been identified as one of the major problems in MOOCs [332, 127]. Furthermore, MOOC learners are rated as representing a vast online learning community with diverse abilities and motivations [162]. In this context, MOOC completion rates have been linked to learners' expectations and motivations and the need to understand participants' goals and intentions [322]. Furthermore, the current MOOC pedagogy is largely didactic and instructor-centred. Most MOOCs lack the flexibility to accommodate learners' different abilities, preferences, and expectations, which is needed to provide genuine inclusivity. In most cases, MOOCs generally present a one-size-fits-all learning experience that offers little opportunity for personalisation or for participants to take control of their own learning. This approach encourages passive learning and increases the likelihood of dropping out [95].

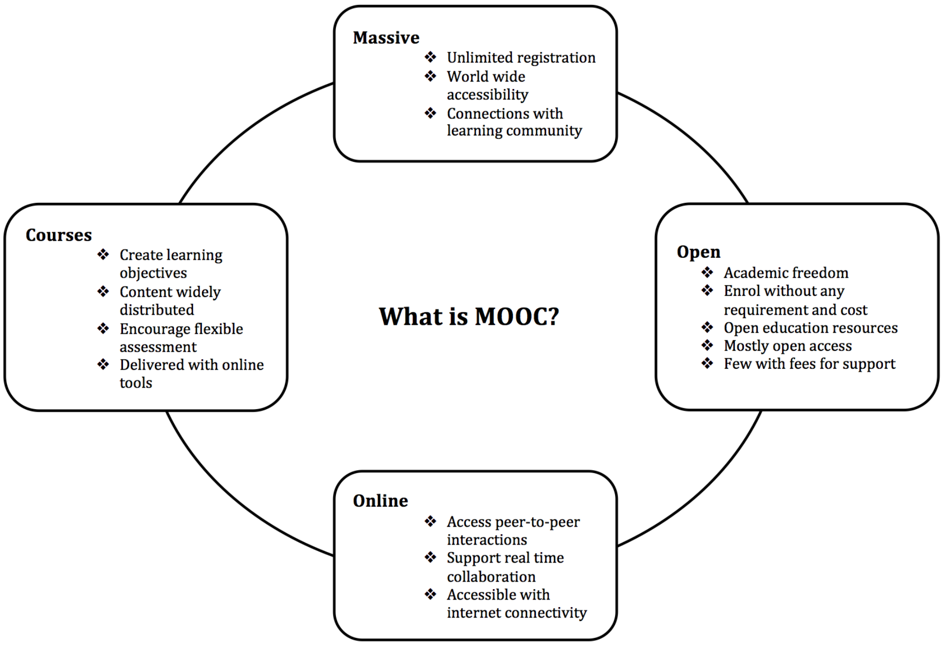

Figure 1.1: Key components of a MOOC platform, adapted from Yousef et al. [341].

The passive and fixed nature of most MOOCs limits the participants' opportunities for self-direction, adversely affecting engagement and the likelihood of completion. In other respects, such as time management, MOOCs make high demands on students' abilities to self-regulate, yet do little to foster these skills. This thesis explores issues of self-regulated learning (SRL) in the context of MOOCs using a novel platform that can support self-direction.

1.2 Problem Statement and Motivation

The MOOC's aim is to provide open access to high-quality learning resources for large number of participants, regardless of their background or geographical location. Despite their rapid rise to popularity and the large number of registrations that MOOCs attract, many people do not finish, with average completion generally acknowledged as being 15% or lower [154]. High attrition has been identified as one of the major problems faced by MOOC providers [282]. The MOOC learners represent a vast online learning community with diverse interests, motivational drivers, and existing learning skills, and while some studies suggest that low completion rates are rooted in factors relating to learner motivation, commitment, and enthusiasm, evidence is emerging that some potential learners do not possess the necessary independent learning skills required to self-regulate successfully and engage consistently within the prevailing MOOC format [319].

Learning in a MOOC environment depends on the capacity of the participants to be effective, self-motivated learners. As captured by the concept of SRL, effective learning skills include aspects such as time management, prioritisation, planning, organisation of study, and self-awareness [22]. Without such skills, learners working at a distance, in their own time, and largely on their own, may find it very difficult to maintain their initial momentum and to progress to completion. Despite this, most MOOCs show little awareness of the demands they are implicitly making and few provide an opportunity for learners to assess and explicitly develop their learning skills. An additional, related problem noted with MOOCs is their lack of pedagogical flexibility and their adherence to 'old-style' approaches of didactic, expert-led teaching [282]. More active and engaged learning strategies and the opportunity to be involved in directing one's own learning are rarely offered in courses on most major MOOC platforms. The widely used, more passive teaching methods, such as video lectures, are less likely to engage students in deep learning.

While pedagogical issues are problematic in current MOOC platforms, some commentators have also raised the point that it may not be appropriate to use dropout rates alone as a measure of success and that even defining what constitutes dropping out can be difficult [65]. Learners who engage with a course at their own pace and to satisfy their individual learning objectives (rather than those of the overall course) may officially count as 'dropouts' yet have interacted with the course to their own satisfaction and achieved their objectives [162]. The point here is not to excuse attrition by redefining the term, nor to try to paint MOOC dropout rates in a more positive light but rather, as noted by Clow [65, p. 4] 'Where we have indications of problems [...] we have a responsibility to do what we can to address them'. That is, if our courses are not offering suitable flexibility to support participants in their preferred ways of learning, then this is a cause for concern. A learner's goal may be to study only certain parts of a course, but the current monolithic nature of most MOOCs means it is very difficult for learners to make informed choices about how this can be done and to find paths that are educationally cohesive that meet their needs. Most MOOCs are standalone, giving no idea of prerequisites for different topics (which would support informed decisions about accessing individual parts) and provide little navigational support for a learner making progress in their own way. Flexibility in this respect also relates to the issue of self-regulation by allowing users to take more control in directing their learning path. In the context that supports such flexibility, 'success' in a MOOC can be related to learners' own motivations and goals [322].

Further, by using a survey instrument to investigate SRL, it is possible to investigate the MOOC learners' strengths and weaknesses in different aspects of SRL and to relate these to their preferences for (and ultimately to their success in) different modes of study.

1.3 Self-regulation in different MOOC contexts

Although MOOCs are rated for their stand-alone course provision, they are also increasingly employed in a blended-classroom approach where some learning activities are conducted at the on-campus site, while others are performed online [227, 117]. Some studies indicate that the learning environment can be challenging to students; however, they benefit from the learning not being fixed to a specific time or place [16, 267]. Students tend to work differently in their different learning contexts, and the skills and strategies they need to deploy to learn effectively are also likely to differ [15]. For example, independent online learning requires students to take ownership of their studies, strategise plans for study, manage their study time, and set learning goals [312, 131]. In addition, SRL provides learners with the ability to improve their learning skills. For instance, solving exercises gives learners the option of deciding what approach they will use in solving the problem. This study analyses groups of learners regarding learning patterns in two case studies using six SRL dimensions in a stand-alone online course and a blended-learning MOOC. Additionally, SRL is important in learning, as this allows the learners to take control of their studies and decide their learning patterns. Students studying in a blended-learning mode do not adequately regulate their own learning patterns effectively because of other priorities that require them to switch their learning behaviours to suit various activities and necessities [257, 29].

Likewise, studies have shown that students do not regulate their own learning patterns because they tend to misjudge the skills they have [328, 329]. They even stop learning before adequately mastering the learning resources [290] and often procrastinate while studying [289]. The inability of students to independently self-regulate their studies has been a major problem both in online courses and blended-classroom contexts [14]. Research indicates that online learners and blended-classroom students need effective self-regulatory skills to be committed and perform well in both online and blended-learning environments [16]. Students who lack self-regulatory skills are unable to exploit the potential of these online and blended-learning environments [14, 29]. Zimmerman and Schunk [356] defined SRL as a process where 'learners personally activate and sustain cognitions, affects, and behaviours that are systematically oriented toward the attainment of personal goals'. The degree to which students engage in self-regulating activities has been revealed to correlate with good academic achievement [247]. Research has shown that fostering self-regulation abilities improves effective performance in several outcomes [136, 309, 16, 25]. Therefore, it is essential that online learning environments are developed in a way that fosters SRL.

This research project investigates a novel MOOC pedagogical approach, which can encourage self-directed learning (SDL) and promote independent learning. To provide the required functionality, it was necessary to develop a MOOC platform that could support learners' individual choices of the learning path and collect data relating to self-regulation skills and strategies.

1.4 Objectives

The overall research objectives are as follows:

- to review existing relevant literature on MOOCs and emerging theories of good pedagogical practice in online platforms, especially MOOCs;
- to develop a MOOC platform that can support novel pedagogical features;
- to implement courses on the platform representing two different (fully online and blended) learning modes;
- to investigate aspects of self-direction and SRL among MOOC learners in both learning modes;
- to collect quantitative data from questionnaires from both courses and provide a comparative analysis and alignment to existing theory;
- to collect qualitative data using focus group interviews to explore SRL skills among learners;

- to identify a suitable theoretical basis from which to explore self-regulation in the MOOC context;
- to reflect on the implications of the work for future MOOC practice and research.

The following research questions provide the focus for this work. An outline of how each is addressed is also provided.

1.5 Research Questions

This section states the specific research questions addressed by this work.

RQ1. **To what extent is self-regulation needed, promoted, and supported in current mainstream MOOCs?**

To address this issue, the study extensively reviewed existing research on SRL and their implication for digital learning.

Research objectives: This study reviewed relevant literature related to the research investigation. Information with respect to the gap identified in a general MOOC system was addressed along with the implications to online learning. The literature review chapter addresses areas in which learners self-regulate their learning and reviews the support received from existing MOOC platforms. The second research question addresses the patterns of learning activities that support learners' choices of learning routes.

RQ2. **What patterns of learner activity and resource usage are observed within a MOOC that support learners' choices of different learning routes?**

RQ2.1. *To what extent do learners choose to direct their own study path as opposed to following a guided course?*

To address this issue, the study investigates and presents support regarding the learner's choice of participation and whether it is in conformity with suggested or directed routes.

Research objectives: We created a tool as a model to present the topics visually to the learners to identify and present the support needed to study in any mode informed by the learner's choices. This structure is visualised to reveal the learning routes within the lessons of the online course and the chosen goals of the learner. Visualisation of online content represents the domain knowledge that is developed to deliver learning resources for specific courses or modules [207]. To the best of our knowledge, there are few visualisations of course content found in most of the existing MOOC platforms to support learners. The concepts used in this study are to determine whether visualising the online course is feasible and useful to the learners.

The other aspects of this research explore the support for self-regulation of learning. The study presents concepts for supporting learning and course activities, such as quizzes, exercises, and a social learning network that could be conducted online. However, our aim is to observe and obtain information on learning patterns by using Google Analytics or the in-built course learning analytics and survey questions to show the exact learning habits and SRL of the learners.

To do this, we have introduced six dimensions as interventions that aim to explore the students' SRL awareness in this study. We predict that drawing the students' attention to these self-regulated skills using the six dimensions of goal setting, task strategy, time management, environment structuring, help seeking and self-evaluation might help them to implement smart reading attitudes and behaviours. The third research question acts as an overview of the research theory by asking whether the learners' capacity for SRL is associated with a path that led to success in the online course.

RQ3. **Does a learner's capacity for self-regulated study relate to the choice of learning paths and the ability to succeed in a MOOC?**

In this thesis, we have investigated interventions that try to promote SRL abilities and provide awareness of these patterns of learning to learners. We investigated how undertaking the MOOC has an effect on self-regulated levels. We evaluated two paths as an intervention to mitigate the issues regarding accessing the course: the first is the self-directed path and the second is the instructor-led path.

Research objectives: The visualisation of the course and its content in the eLDa MOOC platform that was developed for this study, allow learners to direct their learning paths. In this path, the learner could see other lessons or modules which they wish to study and they could easily switch modes and decide on a new path to follow. For learners to achieve beneficial practice while studying, we visualised their progress, which shows the lessons they have covered and the next concepts to study (or those yet to be studied). With the adapted questions in an online self-regulated learning questionnaire (OSLQ), we aimed to identify how MOOCs can be structured to actively support the development of SRL. These were measured using a designed MOOC OSLQ (MOSLQ) in the eLDa MOOC course. These were also measured using copies of questionnaires and semi-structured focus group interview questions in a blended class. The fourth research question addresses the self-regulatory skills observed from diverse MOOC learners and identifies some common weaknesses among these learners.

RQ4. **What levels of SRL skills are observed in students' learning in a blended-classroom context and an online course learning context? What are the areas of deficiency that need improvement?**

This also shows whether those who set their learning goals are achieving them or what could help them to change their learning behaviours. Although our study shows low SRL skills among the student population, their weekly assessment results prove otherwise.

Research objectives: We aim to identify, given the choice of self-directed or instructor-led study, whether the patterns of use within the system help foster learning support. In addition, we aim to identify whether the students' capacity for SRL is related to their success in achieving their goals or to their choice of mode. We will investigate whether a student's capacity for SRL changes during the course and whether students are more likely to achieve their learning goals in the online learning environment given the choice of mode. These objectives were evaluated using learning analytics, surveys, and focus group interview data. The fifth research question investigates whether existing conceptualisation of SRL was appropriate for a MOOC in a stand-alone and/ or blended mode course.

RQ5. **Are existing conceptualisations of SRL appropriate for MOOCs in a stand-alone and/or blended mode?**

In this case, we considered comparing the SRL results from the two experiments to identify any association between them. However, the result is somewhat different because we have observed weaknesses from some related dimensions within the diverse MOOC learner groups. For example, both groups show weaknesses in the overall 'help seeking' dimensions. While some learners perform well individually in some of the dimensions, they have some weaknesses in others which need improvement.

Research objectives: We wanted to identify which of the learning modes learners would prefer given the choice of two modes: self-directed or instructor-led study. Second, the study aims to identify whether a student's capacity for SRL relates to their success in achieving their goals within their choice of study mode. The third aim is to investigate whether the students' ability for SRL improves throughout the duration of the course. The fourth aim is to investigate whether learners are more likely to achieve their learning goals in the course given the choice of mode than to complete the course in its previous format. In addition, the study aimed to identify whether the learners' perceptions of the course were beneficial to their learning habits. The study also sought to investigate whether the mode of study in any way improved the academic success of the students. We investigated whether the level of SRL skills has any effect on the academic success of the blended-learning environment students.

To help us measure these objectives, we conducted a semi-structured focus group interview, in-course surveys and questionnaires, and collected data from the built-in course learning analytics. The research question addresses the SRL observed from the students and whether there was any effect drawn from the deficiency that was reflected and whether these have any effect on their weekly assessment. The sixth research question addresses the implication of MOOC pedagogy to support SRL.

RQ6. **What are the implications for MOOC pedagogy to foster SRL?**

This shows the implication and effect of the study to foster and support SRL among learners.

Research Objective: This is made possible by the paths and instructional guidance of the research tool. As the tool allows the learners to decide their learning paths, it gives the learners the opportunity to pursue an autonomous learning habit, which is developed over time to aid their learning direction.

Section 1.6 describes the overarching research methodology and conceptual methods that helped in investigating these research questions.

1.6 Methodology

This section provides a brief overview of the methodology used in the research. Full details may be found in Chapter 3.

Design Science Research Methodology: The overarching approach adopted in this work is derived from the design science research methodology (DSRM), which is a paradigm centred on the development and evaluation of an inventive artefact to investigate a precise problem or problem domain [327].
Overview: This research applied a conceptual approach depicted in Figure 1.2, adapted for this study, that explains the process of this research investigation [338, 339, 337]. This shows the research processes, analysis of the collected data, and the interpretation of the findings [340].

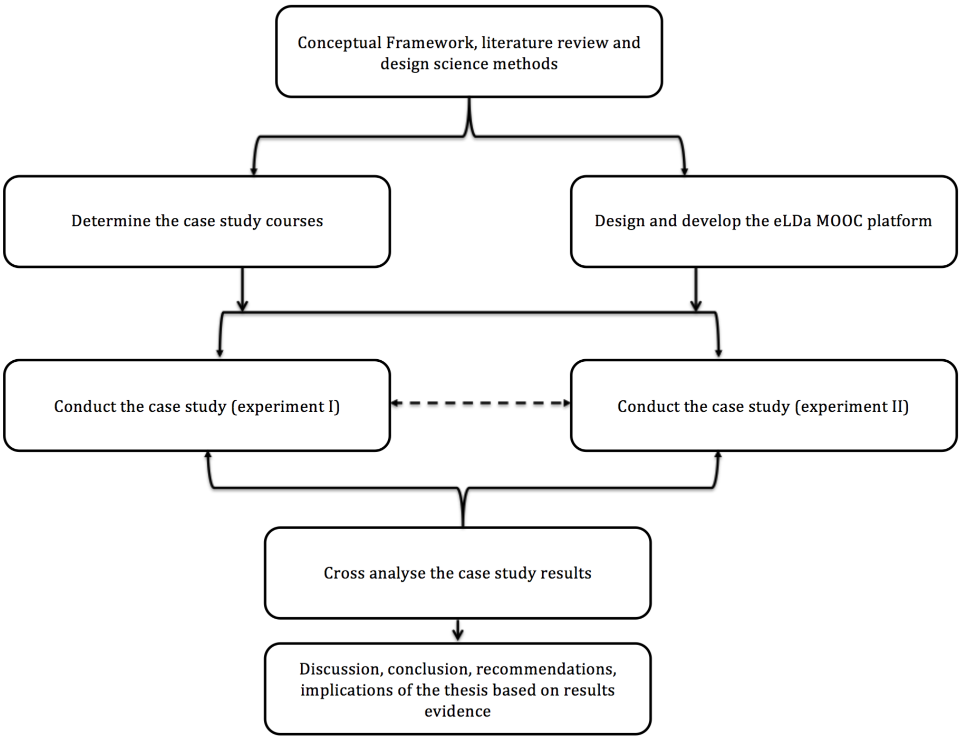

Figure 1.2: Visualisation of the research approach adapted from [340] and [337]

Qualitative and quantitative approaches: Mixed methods of qualitative and quantitative research approaches were used for organising the data collection process. Qualitative methods are best suited for confirming hypotheses and predictions that were expected to be the results.

Data collection methods: The primary data collection methods were surveys and semi-structured focus group interviews.

Collected data: This study data were collected from MOOCs in two different types of learning: fully online and blended-learning. The data were collected from the courses via online surveys and from students.

Participants: The learners for this study were from (i) a fully online computing MOOC and (ii) a first-year undergraduate computing course in which students were studying in a blended mode. These participants were selected based on both purposive and convenience sampling.

Data analysis approaches: In this study (detailed in section 3.7), the various phases and procedure of the data analysis use thematic [107] and content analysis [100, 68]. The process of content and thematic analysis used in this study is to enable the researcher to search for important emerging themes that could be coded and categorised to describe the phenomenon of interest in the study [84]. The process, similar to another related study, was implemented with careful iterative reading of the transcribed text for sufficient identification of themes from the raw data [246]. In this process, emerging themes become the classified categories used for data analysis.

Theoretical basis: The theoretical basis for this study is investigating SRL among fully online course learners and blended-learning students. The conceptual instrument used for this investigation was a modification of an existing SRL survey.

1.7 Significance of the Research

The study has presented broad knowledge of MOOC pedagogy and produced an extensive literature review on MOOCs and their strengths, weaknesses, effects, and contributions as a complement to the traditional educational system. The extensive understanding of MOOC innovation is necessary in the 21st century to support effective MOOC structure and pedagogy to aid online learners. In this thesis, we investigate SRL in a digital learning environment, considering different learning settings and using emerging educational technology.

This study shows that SRL can be obtained from a MOOC approach of learning. Visualisation is applied to support implementation of a novel MOOC pedagogy. More specifically, from the online course perspective, this study investigates two modes in which learners direct their studying: self-directed and instruction-led modes. The researcher also analysed the learning route of individual learners in the learning environment and observed the individual SRL skills within the modes of learning. Using a focus group with semi-structured questions and copies of questionnaires, SRL skills were investigated among blended-learning students. Blended-learning element in this study encompasses discussions on the SRL behaviours of university students taking part in seminar classes. The focus group interview gathers the perceptions of SRL in a blended context and exposes aspects of learning in a blended course.

These students realised more about their own learning skills by acquiring understanding of what they can do and what they can improve on to achieve their full potential. By participating in the focus group discussion, it helped to transform the students to become better learners and increased their self-esteem and confidence. The focus group was significant for the students gaining knowledge on the views and reading styles of other students and applying these concepts to improve their SRL skills. The focus group study is important because it boosts the confidence of the students, leads to better-quality work, and helps boost personal development. This study is about more than academic success, it is also about the way that it can influence a student's life in positive ways, such as by developing effective communication skills for a better future career. Some of the results from this research could be applied in more general online learning settings that utilise comparable teaching approaches.

Another aspect of the significance of this study is to educate instructional designers on the importance of incorporating good practice in MOOC pedagogical design. The architecture of the platform design is simple to understand and could help novice course designers to adapt the concepts as applied in this study. The most significant aspect of this study is found in exposing areas of strengths and weaknesses in the SRL dimensions among the learners. This knowledge obtained from the study helped in identifying SRL dimensions that needed improvement among the individual and collective learners.

Another vital discovery in this study was clarifying that the measuring instrument adapted for this study could not prove existing theories; therefore, this study could not sufficiently agree with other studies that argued that students who are high self-regulators perform better academically compared to those who are low self-regulators [29]. This study disproved this popular theory in the blended-learning course (full details in Chapter 7). However, the study recommends that specific instruments used in a study successfully may not necessarily be effective in other related studies.

1.8 Research Contribution and Novelty

There are several existing platforms that embody learning concepts with different objectives and goals. While these existing research platforms make provisions to support learners in their choice of learning, few of the platforms focus on learners' objectives and choice of learning. Most of the platforms are instructor-led, focusing on the developer's (or educator's) objectives rather than on the learner's needs. Most MOOCs that are being developed nowadays are not fully learner centric. There is a need for research that can further understand the challenges of SDL. This platform concentrates on investigating the SDL mode (or self-study mode) and instructor-led mode to help understand SRL habits. Thus, there is a need to consider the learner's choice of learning as a current state of the art in designing MOOC pedagogy to motivate the support for learning effectiveness. There is a clear need for support and guidance, which can focus on the perspective of MOOCs design patterns to investigate SRL [186].

The novel contribution of this thesis is found in the aspect of providing a MOOC platform designed with two paths (self-directed and instructor-led) to access the course. First, this platform provides the entire course content visually to the learners to allow them to decide which direction to follow to study the modules. The visualisation of the course content allows the instructor to identify concepts that are of concern for many learners and students. In addition, visualisation also shows the topics that are most studied and least studied by the learners when observed using learning analytics. The instructor may also observe the learners who are active and inactive participants in the course [206].

The platform presents approaches that support patterns of engagement by self-choice and pedagogical instructional support. The other novelty of the platform is to investigate the development of SRL skills. This platform placed importance on key aspects of SDL that allow learners to achieve their goals: (1) allowing learners to make their choice in learning and (2) providing guidance towards a pedagogical path of learning. Most MOOCs are developed in a structural one-size-fits-all approach in delivering courses. Most of the course structures for learning are not focused on the learners' perspectives and mode of engagement. The eLDa platform focused mainly on how to combine these two modes of learning to create an effective pedagogical learning experience. However, this thesis, in its case study, provides a contribution to enlightening MOOC platform developers and instructors to be guided in designing a better learning management system (LMS) using these modes that are based on learner-centric perspectives. The following scenario is introduced to provide examples of the understanding of the eLDa learning environment and learners' patterns of learning.

The eLDa self-directed scenario: A learner registers and decides his or her learning path and pattern. The entire course content is visually displayed to the learner. The learner determines the mode in which the learner is interested in engaging. In each of the seven modules in the course but one, there are five lessons apart from the introductory module that has three lessons, including practical exercises and solutions. Each of the modules discusses computing concepts and Python programming. Learners have the choice of engaging with the course by watching lecture videos, reading the text transcripts of the videos, reading the lecture resources and slides, and accessing external links and resources suggested for further clarification or enlightenment.

The eLDa self-regulated scenario: At this point, the learners prepare ahead for the lessons or modules. They set learning preferences and goals to achieve in the course. However, the researcher hoped that, with the combination of these two modes of study in the platform, learners could develop skills needed for enhancing personal or independent SRL habits. These skills will help learners to autonomously take control of their reading and learning skills.

Chapter 2, subsection 2.8.6 describes these two concepts, their similarities and differences, and how they are applied in learning in more detail.

1.9 Thesis Outline

The chapters in this thesis cover the areas briefly outlined below.

Chapter 2

Chapter 2 presents a literature review covering the existing MOOC systems, the background, the gaps observed, and history of the institutions developing MOOC content and the pros and cons of MOOC establishment as well as the MOOC dropout rates, good practice pedagogy in MOOCs, and SRL.

Chapter 3

Chapter 3 describes the methodology used to answer the research questions. It also presents the measures, approaches, and techniques applied in answering the research questions presented in this chapter. This includes both the approach taken and the specific methods used for data collection and analysis.

Chapter 4

Chapter 4 describes the design principles and implementation of the eLDa learning platform. The features and components of the learning platform are described along with the specific courses implemented as the vehicles for data collection.

Chapter 5

Chapter 5 describes the initial study conducted after the system design and implementation. The pilot study provides insight on the usage of the platform and facilitates acquiring feedback on how the online course could be improved. The initial results from the pilot study were extended as ongoing findings with the results of the officially launched live system presented in Chapters 6 and 7.

Chapter 6

Chapter 6 illustrates the results of the online course case study and describes the various levels of SRL skills shown by learners and those that need further improvement.

Chapter 7

Chapter 7 describes the second case study conducted in a blended-classroom learning environment. The chapter describes the individual SRL skills and aspects of the dimensions that need improvement. The chapter further illustrates the interpretation of the data collected from the two focus group interviews that were conducted to investigate the SRL skills of the blended-learning students.

Chapter 8

Chapter 8 describes a comparison of the stand-alone MOOC and the blended-learning concepts and describes the motivation of the students in learning. It also discusses the levels of self-regulation among the learners, explains the significance of the focus group study, brings together findings from both case studies in a general discussion, and finally provides discussions on the implications and significance of the study.

Chapter 9

Chapter 9 presents conclusions, the research contributions, challenges and limitations of the study, and provides recommendations for further research directions.

1.10 Summary

This chapter has presented the statement of the problem, the research motivation, the research questions, the objectives and measurements, and the map of the outlines of the chapters to answer the research questions. This research applied a mixed-method design [278]. In this study, descriptive statistics were conducted based on the closed-ended questionnaires from both the stand-alone course and blended-learning course. In addition, emerging themes from open-ended focus group interviews and survey items were qualitatively analysed. This presents the novelty contribution of the research with examples of the learning process in the eLDa environment.

Finally, there is a discussion on the challenges experienced during the design and implementation of the MOOC learning platform. The biggest challenge in this study was trying to provide a MOOC technology that could complement the objectives of the overall design of the course structure and that could allow learners the autonomy in directing their choice of study rather than working against it, while remaining extremely easy to use, and this has taken a considerable amount of effort to produce the novel platform prototype.

Chapter 2

Background and Related Literature

Chapter 2 presents a review of the related research literature, which provides the theoretical foundation of the thesis. The emphasis of this review is on the unresolved questions relating to MOOCs and their effectiveness. One of the major recurring issues raised in academic literature is the consistently high dropout rate of MOOC learners, and this is explored as a motivating factor for the current work. Recent studies have highlighted the alarming dropout rates in the MOOC process [5, 335, 155, 154, 261, 145]. In relation to this, the chapter considers aspects of MOOC pedagogy, focusing on the issue of SRL. Strategies for supporting self-regulation in MOOCs are identified as the gap in current understanding to be investigated in this thesis. This chapter addresses the following research question.

1. To what extent is self-regulation needed, promoted, and supported in current mainstream MOOCs?

Objectives

- To review the relevant MOOC literature to identify the research areas that need further investigation.
- Directed by the gaps discovered in this review, to identify relevant pedagogical theory (relating to SRL) that will direct the work of this thesis.
- To explore related work on MOOCs and existing MOOC platforms to inform the development of a novel MOOC prototype to support the investigation of learners' self-regulation.

This chapter is divided into nine sections. Following the introduction in Section 2.1 the background of MOOCs is presented. Section 2.2 gives an overview of MOOC history, MOOC organisation, and the issues relating to participation. Section 2.3 reviews current MOOC platforms to gain an understanding of existing provisions and inform the development of the platform to be used in this research. Section 2.4 considers the effect of MOOCs: the positive aspects of these courses, their weaknesses and deficiencies, and the implication of MOOCs for students following both stand-alone and blended-learning courses. Section 2.5 considers the issue of MOOC dropouts in more detail, reviewing existing evaluations of completion and dropouts in MOOCs. Section 2.6 discusses the concept of MOOC pedagogy and reviews best practices in modern MOOCs. The section further describes the concepts of blended-learning in a MOOC context. The current study focuses on learners' abilities to direct and regulate their own learning in both stand-alone and blended-learning MOOCs. Section 2.7, introduces the concept of SRL. Section 2.8 describes the conceptual illustration of the two main SRL models and the conceptualisation of SRL in the online MOOC concept and considers existing instruments used to measure the SRL with specific focus on its conceptualisation within online learning. The last section summarises the main problem areas emerging from the literature that limit the effectiveness of the current MOOCs and have motivated the work reported in this thesis.

2.1 Introduction

MOOCs are said to represent a new, innovative model for delivering free online learning content to learners [141]. Generally, MOOCs have no limits on participation, with some registering hundreds of thousands of learners. In the last few years, these courses have proliferated internationally, receiving much attention from media, entrepreneurial vendors, technology sectors, and education professionals in higher institutions of learning [343]. With no prerequisites, up-front costs, or barriers to entry, MOOCs have been hailed as providing free access, 'cutting edge courses that could reduce the cost of university level education and disrupt existing models of higher education' [342, p. 1] . Despite concerns over this disruption, many elite universities have moved rapidly to introduce MOOCs to be seen by others as innovators in this new educational learning approach. Similarly, a variety of open learning platforms for MOOCs have been developed with initiatives such as edX, Coursera, Udacity, and FutureLearn, providing different approaches to course structure and delivery [274, 333, 137].

The figures on the number of courses, enrolled participants, and completion rates indicate the extent and speed of MOOC growth [190]. For example, Coursera, one of the leading platform providers, is said to have a continuous growth rate of over 6,900 new participants ('courserians') per day [258]. It has 'added 7 million new students and thus has about 17 million students in total' as of 2015 [275]. Coursera is just one of the growing number of MOOC providers creating diverse open online courses, though not all their courses are free [73]. Similarly, FutureLearn is one of the UK free open online courses from leading UK universities for learners all over the world. The first courses were launched in 2013, and since then, over 4 million (4,907,570) participants have registered [112]. For example, The Open University is a partner university with FutureLearn. It is one of the largest academic institutions in the UK and a world leader in distance education. The Open University institution has taught over 1.8 million students and currently has over 220,000 students, including over 15,000 overseas students [112].

Kop [167] stated that MOOCs started from a humble background of collaborative online learning with several people interacting and being exposed to a variety of views, opinions, and ideas. However, over the years they have moved towards a more traditional educational structure, as most of the courses are new shorter versions of a traditional course pattern, which are offered freely, covering several advanced subjects delivered by high standard professors and specialist lecturers from some of the elite universities around the world [258, 167].

Online courses have grown progressively from open access to open educational resources [225], and most recently MOOCs. This new trend is rapidly and consistently growing to bridge the gap between schools and higher education [275, 112, 121]. The rapid and widespread introduction of MOOCs has been accompanied by high expectations of what they might achieve and of the educational problems they might solve for learners in developing countries, providing support for introductory courses for remedial classes and for learners without access to a traditional education system [106]. MOOCs are growing rapidly and changing the paradigm of higher education [151, 167, 168]. The introduction of MOOCs has provided learners worldwide with rich sources of information to learn [150]. In fact, this has been predicted to change the perspectives of traditional elite universities that were said to be established for the rich and influential and now can be free and widely accessible to learners, including less privileged learners [258, 121, 220]. However, this effect has not been fully established, as there is little evidence for these claims [258]. Similarly, some studies show that these under-served or unrepresented minorities in MOOCs who are now privileged to participate in these new trends of education mostly take MOOCs for educational advancement [293, 121]. On the other hand, Stich and Reeves [293] argued that these under-privileged learners were also less likely to complete the course.

MOOCs constitute a movement that has been seen by some as an exciting innovation but which is also referred to by others as a challenge for developing online educational courses that has led to the 'question of their viability as a means of promoting education for all' [132]. Although most MOOCs have organisation and presentation of course material that is well-packaged, instructional design quality has been seen to be low in many MOOCs [200]. In recent times, new learning structures are now surfacing among universities in the form of blended MOOCs. In this new process of learning, blended MOOC learning is keen to provide online education to everyone, especially students at anytime and anywhere in the world with access to the necessary infrastructure, such as good connectivity to the Internet [258]. This infrastructural advancement and the popularity of this method of learning has led to some higher education institutions incorporating the trend to introduce blended MOOCs, which are aimed at combining traditional class interactions and online learning components, which in this case have emerged as an alternative MOOC model for teaching and learning in the higher education institution context [340]. Blended-learning, which is a combination of e-learning and the face-to-face approach, has been regarded as a new paradigm in modern education [60]. The following sections discuss the basic introduction of the history, followed by the types of MOOCs.

2.2 The History of MOOCs

The term *massive open online courses* was introduced in 2008 by Cormier [71] to describe Siemens and Downes' Connectivism and Connective Knowledge (CCK08) course, which highlighted important new pedagogical model characteristics [343, 280, 83]. The course was initially organised for a group of 25 registered learners to study for credit worldwide. However, 2,300 learners were involved in the course. In 2011, Sebastian Thrun and colleagues at Stanford University initiated an open-access online course entitled: Introduction to Artificial Intelligence, and the course registered 160,000 learners in over 190 countries [303, 343]. This huge online class attendance identified MOOCs as a different approach to learning than the traditional model of delivering educational content in higher institutions of learning either on campus, or by distance and flexible learning. Hence, MOOC became a label for higher education institutions, individuals, and commercial groups [126]. Some examples of institutions with established MOOC platforms, such as edX, and commercial establishment platforms, such as Coursera and Udacity, have been launched in collaboration with prestigious universities, offering online courses free or charging a small fee for certification [274, 333, 27]. Similarly, some popular organisations, such as Pearson and Google, are moving into the higher education sector as global players, which most certainly would want to use and adopt the existing MOOC approach of delivery of their courses [343, 326].

The basic idea behind the MOOC initiative was to broaden education and provide free access to university level education for as many learners as possible, which is different from traditional university courses. Wiley [324] and Yuan et al. [343] argued that the ambiguities in the MOOC concept could result in some threat to the future direction of open educational resources and open courses that are free to learners. They claim that less interest would be shown if these excellent courses were to be free and open.

There is an essential need to consider the history of MOOC development to better understand the current position in terms of the best pedagogical practice. For example, in the UK, open educational resource programmes launched in 2009 have successfully made free teaching and learning resources public worldwide with copyright licences for their use, reuse, and repurposing [151]. The progressive and rapid growth of MOOCs has sparked big commercial interest, as venture capitalists and major corporations are interested in the higher education market using the MOOC approach [343]. Most importantly, it has led to a sensitive discussion on the issues of the disruptive effect of MOOCs in higher educational institutions and encourages more established organisations to invest in online learning and free open education as the future of higher education. This act motivated higher education to try to meet the demands of different learners' needs, as they rapidly constantly change. Institutions should be cohesive in their strategies in responding to the rapid MOOC developments, opportunities, and threats in higher education institutions with deep and clear understanding of the analysis of MOOCs [343, 342].

The concept of MOOC originally came from academic research in the early 1960s with people linking to others using computers to listen, discuss, and learn about specific topics of interest [258]. The improvement in educational technologies has enabled many people to gain broad access to free online education and learning based on subjects that they are interested in [167].

Morever, MOOC technology provides a unique platform for learners of similar interest to study and interact on a topic of interest. This approach to learning is known as connectivist learning, with participants from different corporations around the world. Similar to every other online and distance e-learning course registration, MOOCs can register participants from thousands to hundreds of thousands in a single course. Moreover, MOOCs provide access to free high quality online courses, content, and lecturers to which most learners would never be able to gain access [167]. MOOCs offer opportunities for people in remote areas and developing countries to have access to quality education online [160]. People with inspiration to achieve more with their careers and advancement can gain all or some of these through MOOCs [121]. Nonetheless, some authors have argued that the pedagogy and principle associated with the courses were derived from the theory of connectivism [280, 168]. First, based on Downes and Siemens' first introduction of a MOOC in 2008 [280], the literature agrees with two types of MOOC categories according to several pedagogical emphasis models discussed by Grainger [126]. The two types of MOOC described in subsection 2.2.1 are the connectivist MOOC (cMOOC) and eXtended MOOC (xMOOC) [200]. The next section describes these two types of MOOC concepts in detail.

2.2.1 cMOOCs and xMOOCs

Connectivism is defined as a learning that occurs through connections within social networks. The theory 'seeks to describe a complex learning approach in a rapidly changing social and digital world' [280]. The theory or model uses the concept of nodes and connections to define learning. The learners in cMOOC were influenced by the interpretation of learning patterns, the diversity of networks and the strength of the the interactive learning. Studies have argued that the early constructs of MOOCs were based more closely on the original connectivist distributed peer-learning model [72, 231, 126]. The role of cMOOC was fulfilled and influenced by the course facilitator as addressed by Skrypnyk et al. [284]. The diverse nature of MOOC pedagogy has raised various opinions as to whether peer-to-peer interactions can address the diversity involved in learning [291] or whether the design model of the MOOC pedagogy is deemed most appropriate for the learning content [253, 273]. Several studies have shown that specific instructional strategies can enhance effective learning, improve academic performance, and lead to learners' satisfaction in online, blended-learning, or distance education [116, 192, 317, 300].

Open-source web platforms are used by lecturers to deliver their courses. For example, several open-source courses exist on developing good online educational practice, such as the format of the original MOOC, which included connectivism theory and connective knowledge [280, 126]. During this process of learning, the knowledge resides in and is created as a result of the conversation that participants forge during the connections and the created personal learning networks [168]. On one hand, the created knowledge is shared through common goals, endeavours, tasks, and discussions. In addition, the learning focus is made visible, and sharing is facilitated via e-portfolios, connecting with social media, blogs, and reflective posting to forums.

However, the idea and focus here is not dependent on what is known but on the ability to gain the opportunity and capacity to connect with others in the process of learning. Participants become exposed to broad knowledge networks that are formed over open networks, such as social media, and not on closed networks [168]. In this case, large groups of learners could share substantial knowledge to develop bigger ideas and expand knowledge and experiences. In another instance, the curriculum of learning is imperative. Here, individuals are encouraged to navigate in a personalised manner following individual learning paths through the various connections throughout the course resources.

However, in general, the cMOOC design has less frequent coordination and structure than the larger MOOC platforms described earlier, primarily due to the wider pedagogical knowledge required for developing and running the cMOOC [126]. The cMOOC encourages learners to interact in a peer-to-peer discussion using a social medium, such as Facebook or Twitter [259, 76]. In summary, cMOOCs are centred on connecting different learners with similar interests across distributed technology tools to learn and exchange ideas on related course content [284]. This research study incorporated an xMOOC learning system, as addressed in the next paragraphs.

An xMOOC is known to be a type of centralised MOOC that emphasises the instructor control and coordination of the content to be delivered [284]. Studies have shown that direct instructional strategies constitute a teaching presence that plays a very significant role in addressing and modelling the online experience of the learners [10]. In a related study, teaching presence has been known to shape the cognitive and social learning presence among the learners [115]. In another study, instructional teaching has been known to facilitate the knowledge through social interaction among the learning community [118]. Typically, xMOOC design is used on the larger MOOC platforms and is basically constructed with minimal asynchronous support and with structured or expert content and assessment planning. In other words, multiple-choice quizzes, programming assignments, or peer-review exercises are all involved in developing the course so that learners may engage with the content at the time of their choice [126]. In addition, the courses are delivered using an LMS with instructional content incorporating embedded videos, discussion forums, and online quizzes [284].

The discussion forum is a medium to facilitate social learning and interactions as applied in most MOOC platforms. Typically, one of the main aims of this kind of MOOC design approach is to run classes repeatedly throughout the year and yearly on the recruitment basis. In fact, some platforms build in an xMOOC approach, recruiting the best performing graduates who are then considered teaching assistants in some cases. These experienced graduates provide moderation and technical support with limited academic guidance [126]. In contrast to cMOOCs, these approaches to course delivery in xMOOCs are embedded as the centrepiece of the course instructional pedagogy and design. The concept of the xMOOC was developed from the orthodox methods of teaching, focusing on knowledge dissemination though various learning methods, such as the use of videos to explain a concept further, online lectures to described concepts, and exercises and quizzes to evaluate the learners' understanding of the course. The xMOOC is the newer of the two approaches and provides content recommendation to support online learning. As described by Ping [235], the xMOOC constructs an ecosystem that is composed of a technical environment, social environment, and instructional environment, which has led to the revolution of new areas for further research investigation.

2.2.2 Differences between MOOC approaches

The original MOOC concept was the cMOOC developed by Siemens and Downes [280]. Nowadays, several free and commercialised xMOOC providers such as Coursera, edX, Udacity, and so on, are collaborating with elite universities to help publish their courses online [258]. The cMOOCs are based on the connectivism learning theory, while the xMOOCs are based on the participant behavioural learning theory. Furthermore, cMOOCs focus on knowledge construction and devote more emphasis to the learner's autonomy and social networking learning [235]. Table 2.1 reveals the MOOC typologies addressed by Yuan et al. [344]. For xMOOCs, the word *massive* focuses on the scalability of the course provision with revenue streams, while, for cMOOCs, it focuses on the establishment of connections with the learning community. The word *open* for most xMOOCs means open access; however, some courses might charge fees for access, while the cMOOCs are open access, which allows content to be used in other circumstances. The word *online* in xMOOCs focuses on individual learning, while cMOOCs focus on networked learning. The word *courses* in xMOOCs is concerned with the acceptance of content, while cMOOCs focus on learner engagement with fellow peers across the Internet online community in sharing resources and creating their own content [344]. Unlike the original cMOOCs, xMOOCs 'were hyper-centralised, content-based and linear' [200, p. 77].

Table 2.1: Types of MOOC typologies, excerpted from Yuan et al. [344]

xMOOCs		**cMOOCs**
Scalability of provision	**Massive**	Community and connections
Open access - Restricted licence	**Open**	Open access & licence
Individual learning in single platform	**Online**	Networked learning across multiple platforms & services
Acquire a curriculum of knowledge & skills	**Course**	Develop shared practices, knowledge and understanding

The xMOOCs are currently known for being the mass market type of MOOC. Most of the e-learning platforms are designed with xMOOC design principles. This research clearly addresses and uses the structure of xMOOC instructional learning. The design structure of the research tool in this study was developed in line with the concepts of xMOOCs.

2.2.3 MOOC organisation

xMOOCs present organised online lectures handled by one or more lecturers to educate thousands of participants through course delivery, but cMOOCs would not necessarily do so. However, with these large classes, less contact is observed between the participants and the lecturers. For the participants to obtain more clarification on the course and benefit from further explanations of the learning materials, most of the interactions between lecturers and learners are only accessible via online forums [258]. Grover et al. [133, p. 43] argued in their proposed framework that 'design choices reflect the assumption of designers about the ways in which people learn, and should be pushed to reflect the state of the art of knowledge in the learning sciences'. Their argument is that learners control their learning through various personal interactions with the course. In addition, their study further explained that these choices regarding the interaction and assessment are driven by the learner's background knowledge and learning intentions [133].

2.3 Current MOOC Platforms

The development of MOOCs is rooted within the ideas of openness in education, namely, that knowledge should be shared freely and the desire to learn should be met without demographic, economic, and geographical constraints [258]. As explained earlier in the introduction section, the idea was to allow people to access online materials and courses with no cost. Learners would be able to freely register and access courses online wherever they are located. From the Stanford University experiment, several platforms can deliver MOOC-format open online courses. As of June 2013, some widely recognised MOOC platforms, as described by Ryan [258] and Grainger [126], include the following.

Coursera (https://www.coursera.org/) [73]. Founded in 2012 by Stanford academics, Daphne Koller and Andrew Ng, Coursera is currently the largest educational platform for MOOC, and it is a for-profit enterprise for higher educational institutions. They have over 82 partner universities, over 386 courses, and a student enrolment of over 3.5 million registered between 2012 and 2013 [219, 258, 126].

EdX (https://www.edx.org/) [99, 168]. Massachusetts Institute of Technology launched its MITx platform in 2011. It became a non-profit venture when MIT and Harvard collaborated in delivering and organising the online courses; hence, the name was change to edX. Their initiative could be explained as an avenue to investigate how people learn and study online and the various stages undergone to acquire education online at their own pace in a convenient timeframe [51]. The initial association had 28 members including MIT, Harvard, Berkeley, University of Texas Systems, Wellesley College, Georgetown, Australian National University, École Polytechnique Fédérale de Lausanne, University of Toronto, RICE, TU Delft, and McGill. At the beginning, over 63 courses were available initially and millions of students enrolled in the early stages [258, 126].

Udacity (https://www.udacity.com/)[310]. Sebastian Thrun founded Udacity in 2011. This platform is a profit-oriented enterprise for higher education, which works with individual academics as well as technology firms to develop educational technology for computer science related disciplines and industrial technology. As of 2013, it has offered over 25 courses and registered over 400,000 learners [302, 258, 126].

FutureLearn (https://www.futurelearn.com/)[112], Open2Study (https://www.open2Study.com/), and Iversity (https://www.iversity.org/) are basically platforms for MOOCs originating from the United Kingdom's Open University, Open University Australia, and a German education start-up respectively. All three seem to be in 'competition with the US-based MOOC platforms' at various stages of online course development [258, 126].

Veduca (http://www.veduca.com.br/). Veduca was a MOOC platform that originated in Brazil. It is the first MOOC platform from the Latin American regions. This MOOC provider curates publicly available videos from universities, such as the University of California at Berkeley, Harvard, and Columbia Universities, translating the courses into Portuguese subtitles. The firm also offered the first Latin American-based MOOC from the University of Sao Paulo [311].

Khan Academy (http://www.khanacademic.org)[160]. The platform was developed for kindergarten pupils to learners who are 12 years old. The course is developed to teach mathematics and sciences, such as biology, chemistry, and physics including some elements of economics and history [258]. In 2006, Khan Academy emerged as a global leader for early online teaching. With some initial support from the Bill Gates foundation and other funding bodies, Khan Academy started exploring the web to deliver high quality foundational education for free across a wide variety of subjects with different language diversities. Although Khan Academy was originally from outside the educational sector (academia), it is one of the first MOOC providers [285].

2.3.1 Comparison of MOOC platforms

Coursera is said to have the highest number of online learners and to be the largest online course provider of MOOCs in the world. The platform added 7 million new students to its user base, making the number of registered students 17 million. The three big existing MOOC providers are Coursera, edX, and Udacity. However, FutureLearn increased in student size in 2015 and now has more learners than Udacity, making it the third largest MOOC platform provider in the world. In 2015, Futurelearn grew progressively with a 275% increase rapidly approaching a total of 3 million students [275].

Another interesting aspect observed within these various MOOC providers are the courses that they delivered. Individual providers show their numbers and their greatest strengths in single course sessions (as seen in Figure 2.2). For example, FutureLearn registered over 440,000 students for one of their single course sessions. This makes the single course the largest session of a MOOC. Moreover, edX was the first MOOC platform to go beyond issuing single course certificates as of September 2013 for completing a sequence of courses. In 2014, Coursera and Udacity launched similar programmes. These 'big 3' are competing to established their marks by creating new credentials, using their brands.

The main goal of these credentials is to demonstrate the competence level for high demand skills. The downside is that many students are sceptical about these credentials. Fees are charged for these credentials, and many still doubt the value of these credentials in the marketplace and even in careers, the value of which has not been well established. On the positive side, with quite a few learners pursuing the credentials, this small level of success has allowed both Coursera and Udacity to raise funding in 2015 to create more credentials and awareness. However, one weakness found in these MOOC providers was the massive growth of technical and business-oriented courses, which has led to a drastic decrease of students in humanities and social science courses. Figure 2.1 reveals the top three providers by the number of courses in 2015, which were Coursera, edX and the Canvas Network. Coursera, however, has the largest courses and its course catalogue is twice as large as that of edX [275].

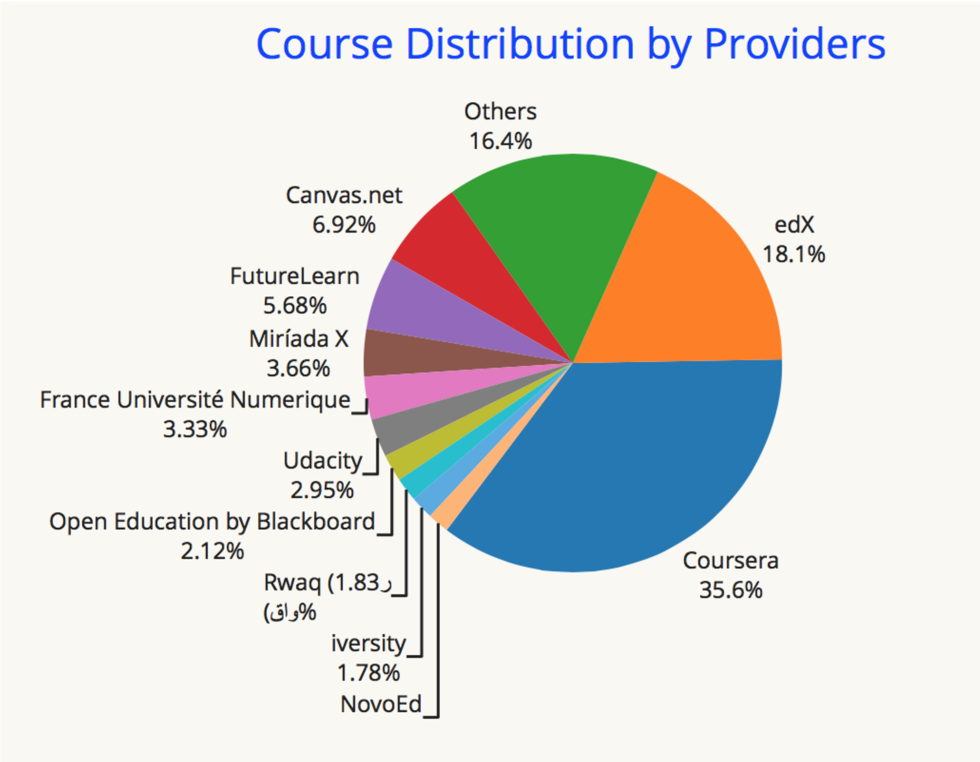

Figure 2.1: MOOC platform providers' course distribution, excerpted from Shah [275].

2.3.2 Different platform languages

It has been noted that the first three big MOOC platforms were designed initially by English language instructors due to their origin. Reports reveal that, as of 2014, the percentage of English language courses has reduced slightly from 80% (in 2014) to 75% (in 2015). These drawbacks came about due to an increase in region-specific providers, for example 'FUN', which was supported by the French government, and MiriadX [275]. Another interesting factor affecting this reduction lies in the fact that Coursera, which originated from United States, is now expanding to international regions, thus allowing the development of courses with regional languages. English, French, and Spanish are said to be the most popular languages used in most MOOC platforms, as seen in Figure 2.2.

Barak et al. [26] mentioned that, despite the different languages of instruction in their study, the MOOC participants were driven to learn by similar motivational objectives and goals. However, courses are being developed for over 16 different languages [275]. Boyatt et al. [48] argued that clear majority of MOOC delivering 'is predominantly English'. This would lead non-fluent English speaking participants to withdraw from the programme due to the lack of understanding of the terms and concepts used in delivering the lectures. This would alleviate much translation in MOOCs delivery platforms to a specific national language, which could reduce the dropout rate from these areas.

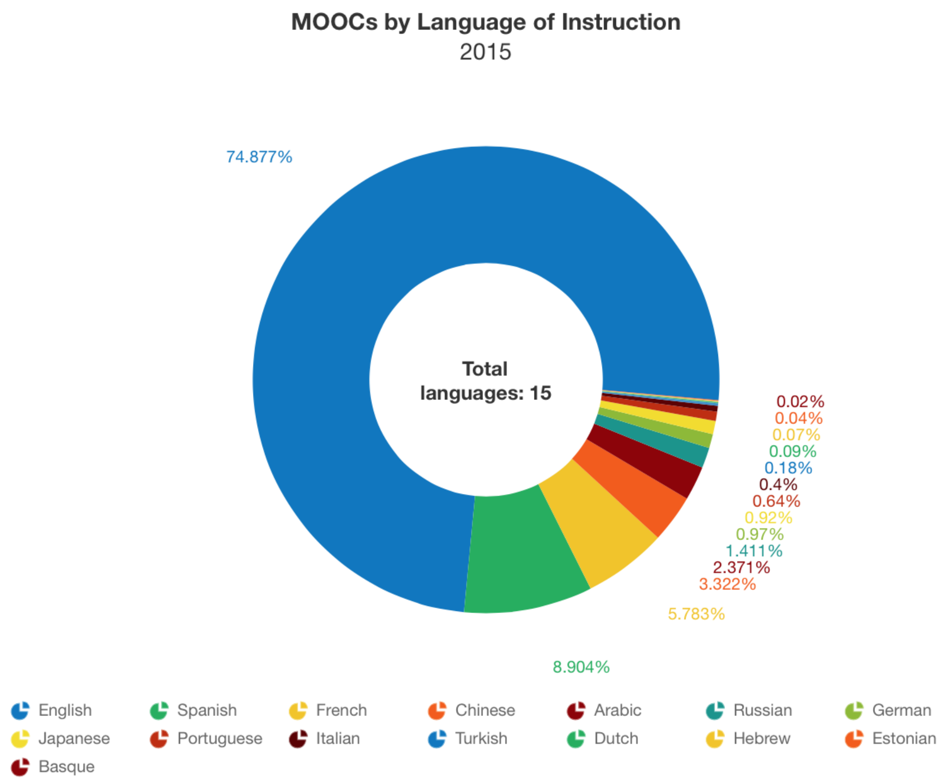

Figure 2.2: MOOC providers by instruction language excerpted from Shah [275].

2.4 Effects of MOOCs

2.4.1 Outlining usefulness of MOOCs

This section explains the usefulness of MOOC to enhance learning. Considering the perspective of educators, MOOCs can be used for the initial training of pre-service or in-service teachers [233], which in turn will be beneficial to students in educational institutions and to distance learners [113]. The clear majority of MOOC systems are administered free of charge. As explained, MOOCs are made available to everyone around the world if the Internet is available. Those who are willing to participate but could not obtain the threshold selection criteria are not prevented from doing so. Most of the MOOC activities and resources can be accessed at the learner's pace. Some critics continue to argue about the low completion rate, but the positives of MOOCs overwhelm the criticisms. This is, learners still engage with the course with no intention of completing the course.

Most learners are there to explore the new trend and investigate concepts in MOOCs that are of interest to them [258]. With the introduction of discussion forums, which have led to helpful interaction, most of the learners seem to develop more interest in the course. Nonetheless, with these interactions, learners are exposed to essential ideas and obtain more understanding from a new perspective. Given that MOOCs are globally accessible and that the participants cross different nationalities, learners could develop a well-exposed worldwide knowledge of the current learning trends around the world. The MOOC has introduced a broader scope of learning for those willing to participate and commit. With the vast exposure of MOOCs, this may lead to a free choice of courses online. On the other hand, this could motivate more development of adaptable courses that are tailored to the learner's needs [258]. Some research has shown that MOOCs could be 'a new-term technology' to adopt in the nearest future [152].

2.4.2 Weakness and deficiency of MOOCs

This section describes the weaknesses and deficiencies observed in a MOOC system. The MOOC platform operates based on a one-size-fits-all principle. The platform development is predominantly established among the developed countries [240]. At the initial stages, MOOCs lacked some structure and did not include the central role of the instructor as seen nowadays in most online courses. Because MOOC platforms predominantly use an SDL style, this makes it different from the formal education experience. The open nature of MOOCs has created a self-selected population who are passionate about this new approach of learning and about engaging in their own way. In fact, MOOCs require participants to have digital literacy, which has also raised some concerns regarding the inclusiveness and equality of accessing the courses [188]. This leads to the consideration of the ways to reduce the MOOC dropout rates.

Nowadays, most MOOCs provide certificates or statements of accomplishment but do not offer academic credits, leading to some concerns by the learners. To achieve a recognised qualification, is there any need for academic credits for MOOC participants? In terms of the security of learning devices, is there any protection for the vast use of mobile devices in MOOC learning [258]? Most of the course design encountered difficulty in navigation in most MOOC systems in the early days, and they also lacked effective interactive interfaces, which affected most of the participation and thwarted the learning experience, which leads to a negative perception of the course [188]. One negative effect of MOOCs is the ineffectiveness of good practice of instructional content [17]. Some studies argued that the highly essential and critical element for success of MOOCs is primarily limited from the aspect of the learners' perspective on gaining more experience from the course [215, 259].

2.4.3 Implications of MOOCs for student learners

The MOOC introduction and design structure has led to many learners benefiting from online interactive and collaborative learning [346]. This has brought learners from different parts of the world under a single course platform to study and exchange ideas. Moreover, MOOCs provide the opportunity to venture into new areas and expose learners to other innovative studies around the world. Equally important to mention is that MOOCs may expose learners to new areas for further study. This might help support learning in a formal education, which could alleviate the cost and duration of a traditional education system. Students who participate in the MOOC could broaden their knowledge in a specific course area without incurring fees.

On the other hand, learners could gain the opportunity to interact with others with diverse backgrounds, knowledge, and experience [299]. One of the most significant aspects is that all the participants can contribute to the virtual learning environment as compared to the on-campus setting, where some students feel intimidated to contribute in a group or class discussion [258]. Some students developed supportive attitudes and genuinely care for fellow learners online. The MOOC forums enable real connections with learners studying online. This genuine interaction leads to giving and receiving encouragement and helpful feedback from peers studying similar subjects. The students could participate online in an interactive discussion and collaborate and learn from participants' sharing of experiences [297]. Discussion forums in MOOCs are characterised as a way of integrating SDL or independent learning among students and incorporating interaction at a learner's pace [115]

2.4.4 MOOC involvement with higher education

Involvement of higher education institutions with MOOCs is growing daily. Lots of institutions are interested in collaborating with existing MOOC platforms. Some MOOCs support providers and others are setting up open-source in-house MOOC systems for higher education institutions. Institutions recognise the MOOC principle as a good practice and a way of improving learning that could also be used to evaluate the delivered courses [19]. Despite these new, open, and mostly free online courses, some educational institutions could see this as a threat, as some might feel their learning resources are mostly designed for fee-paying students. In contrast, some higher institutions might welcome the idea as a laudable one, as it will open an opportunity for them to expose their institution, which could help in attracting more students. The MOOC increases institution consciousness regarding the use of digital technology [88]. In addition, providing a system to investigate the students' understanding of MOOCs and providing credit or help to participants to prepare in a self-regulated manner at the institution could help the participants complete their formal education.

However, on the positive side, if higher education creates an efficient awareness of their courses, their environment, and the learning materials of the institution, this could inform new applicants (students) on the programmes offered by the institution. The experience acquired from the course could encourage the students to progress further with their studies in the institution by enrolling and taking a course in formal educational programmes [258]. Some academics and researchers hope that there will be a breakthrough in MOOC interactive learning in higher education with the various aspects of experimentation occurring in higher educational institutions of learning [86, 169].

2.4.5 Defining and understanding success in MOOCs

In another instance, Ng and Koller [219] and Kolowich [166] claimed that 'most students who registered for a MOOC have no intention of completing the course' and that 'their intent is to explore, find out something about the content, and move on to something else'. Grover et al. [133] argued that casual middle-aged learners taking a course out of curiosity will not put in a lot of effort in the formative and summative assessment required for full participation in the course, as expected. In another instance, Cross [79] adduced that professional learners registered for MOOCs out of curiosity to acquire knowledge and learn how to design MOOC systems for their institutions. Another study compiled the data completion rate of MOOCs, revealing that less than 7% completion was observed [230]. The study claimed that 'the average MOOC completion rate across the 29 courses of which they have organised was just 6.8 per cent'. In addition, 'Five of the top six most completed MOOCs relied on automatic marking alone, meaning that no peer assessment was required. Courses that relied purely on peer grading generally fared far worse in terms of the percentage of students reaching the end' [230].

In another instance, Goldberg et al. [123] argued that completion rates of MOOCs overall are very low at between 5% and 10%, and the participants mostly were learners with higher education degrees. The measure of completion rates in the MOOC context referred to learners who obtained the certificate at the end of the course. It has been reflected in *The Economist* press that, because the clear majority of MOOC providers, such as Coursera, Udacity, and edX, do not initially provide a degree, this might be one of the reasons for the observed high dropout rates of MOOCs [97]. However, despite these factors, the flexibility of some MOOC platforms could provide an accessible environment for a broader spectrum of participants [123].

In conclusion, this analysis has demonstrated the success of the MOOC system through the very few responses from the participants with respect to difficulty. Their main objective was to start each course weekly in an easy manner and early enough to encourage participants' devotion and develop exercises so that the learners could work in their zone of proximal development and direct their learning [315, 314].

2.5 MOOC Dropout

This section presents the fundamental motivation for this research thesis. Furthermore, an existing review of the factors influencing MOOC attrition and the reasons for engaging with the course at the initial stages is explained in detail. In subsection 2.5.1, we present existing findings on MOOC dropout rates and completion rates from some selected institutions and platform providers who have large MOOC organised platforms.

2.5.1 MOOC dropout and completion: Existing evaluations

This section addresses the causes of dropping out and the low completion rates observed within a MOOC. A related review of institutions running MOOCs and the discussion of their findings is illustrated in this section. Most of the major MOOC platforms providers collect large amounts of data, but access to this is not generally available. Only a few specific institutions have taken the time to provide data and analysis on courses they have delivered and have published some of their evaluations. These analyses provide a valuable source of information on a variety of aspects relating to learner background, engagement, and attainment. This section focuses on data relating to participation and dropout rates in this study. A review was conducted from the University of Edinburgh with respect to the six MOOCs that were launched on the Coursera platform in January 2013 [98, 73, 318]. The information in this section was obtained from a published report on these MOOCs [98]. These few reviews were selected because of the comprehensive information presented in the report. The reports revealed the levels of engagement within the courses as well as the dropouts, completion, and other activities, as observed in the early trials.

The University of Edinburgh started with six short, fully online courses that ran for five to seven weeks and attracted a total initial enrolment of 309,628 learners. Six different course structures were developed. In addition to the usual features of the Coursera platform, new methods of content delivery and collaborative learning were introduced. Evaluation of the Edinburgh MOOCs revealed that 123,816 of those enrolled (about 40%) accessed the course sites during the first week (active learners), of whom 90,120 (about 29%) engaged with the course content. Over the duration of the course, the number of active participants rose to 165,158 (53%). As a gauge of persistence, 36,266 learners (nearly 12%) engaged with the fifth week assessments. This represents 29% of the initial active learners, although interestingly, there was a large variation across the six courses ranging from 7% to 59%. Obtaining a statement of accomplishment required attainment of a certain percentage in the assessment (the specific level varying between courses) and 34,850 people achieved this (roughly 11% of those who enrolled). The report provides more demographic data and analysis, but engagement and dropout rates are not investigated further with respect to these [98, 74].

A further case study is available from Duke University, which ran a bioelectricity MOOC in 2012 [35]. In this evaluation, figures are presented in a different way from the previous study; therefore, direct comparison was hampered. However, 12,175 registrations were made, of which 7,761 students watched at least one video. This figure, representing around 64% of enrolments, might be compared to the Edinburgh figure of 53% for those who were active at any point during the duration of the course. Statistics on resource access (such as video viewings) gave one measure of participation, but as students may access each resource many times, it does not show how many participants were still active at any point. Quiz submission is perhaps a more useful metric, and in the Duke MOOC, 3,200 students

(26% of enrolments) attempted at least one quiz in the first week. This might be compared to 29% of Edinburgh MOOC students who engaged in the first week. The statement of accomplishment for this course was again based on reaching a certain level of achievement in the quizzes, and 313 participants (2.6%) attained this level. This was on the low side, even for MOOC completion, and the learners' feedback suggested three specific reasons for failure to complete [35], which are addressed in subsection 2.5.2.

A third useful evaluation is available for the UK Open University's Open Learning Design Studio (OLDS) MOOC [79]. This was a smaller course, with 2,420 registrations. Nearly half of these (1,197) accessed at least one key course page in the first week. The report provides a rich analysis of user perspectives, participation, and interaction. The course itself was experimental and designed to promote social learning rather than simply presenting course materials. Participants were asked to suggest criteria of success and to set their own learning goals. In this type of course, it is very difficult to provide a simplistic 'completion' measure. The report refers to 'approximately 30 active contributors and at least 30-60 other participants' according to Cross [79]. The study reveals that only 22 learners completed the post-course survey, but of these, only half felt they had achieved their learning objectives.

These three published case studies provide interesting information on a variety of aspects, including engagement and dropout. However, the different measures that were gathered, the varying ways in which the statistics are presented, and the different perspectives on 'participation' and 'success' within the courses themselves make it difficult to provide a direct comparison between them. Of course, the general trajectory is clear; many enrol, fewer start out, and a small minority complete the course.

A full compilation of MOOC completion data has been conducted by Jordan [154, 155], which provides a collation of available data on MOOC completion rates. The trends in completion show a typical completion rates of 5% from a range of 0.9% to 36.1% [155, p. 147]. This is an ongoing initiative that provides a useful resource for basic comparisons. In May 2014, 169 courses are represented, and completion rates may be viewed according to factors such as course platform design, institution, and length of content. Shorter courses were observed to have higher completion rates, while small courses (with up to 200 enrolments) are much more likely to have a completion rate of over 20% than larger courses. Furthermore, MOOCs that rely on peer grading often had very low completion rates. The compilation comprises courses from 13 different learning platforms, which are currently represented in [154], with only three of these contributing more than 10 courses. Further analysis of the data shows that, for the 61 courses hosted by Coursera, the average completion rate was just over 6%. Some examples of completion data were recorded from a specific platform: the Open2Study courses, of which there are 64 very short four-week courses that are automatically graded. The average completion rate for these was just under 30%. The edX courses, which included 19 in total, were generally longer in duration, with only one being less than 10 weeks, but all were automatically graded. These had average completion rates of around 8%.

Another interesting comparison can be made between two different presentations of the same course using different platforms. The MITx offered circuits and electronics 6,002x in March 2012, and the same course was offered by edX in September 2012. The first run had 154,763 registered participants, of whom 7,157 completed the course (4.6%). The later edX delivery had 46,000 enrolments and 3,008 completions (6.5%). Therefore, the dropout rates for the course are broadly similar across the two platforms [154, 183]. According to De Waard et al. [87], Google group registered 556 participants in a course, of which only 74 participants were active members, which made up only 13.3% of the population, and a high dropout rate of about 86.7% was observed. Although the collected data builds a useful background picture of MOOC completion, it does not evaluate or even suggest the underlying factors and features that may contribute to learners' decisions to continue in a course. Subsection 2.5.2 examines possible contributing factors to dropping out as identified in the literature.

2.5.2 Reasons for dropping out

Although several reasons for the student dropout rate have been suggested, there has been little research to assess how far these influence MOOC learners in practice or to identify which are within the sphere of influence of MOOC developers.

No real intention to complete: Several authors have noted that reasons for participation given by users often include motivation, such as 'out of curiosity' and 'to learn more about MOOCs' rather than to learn the subject itself [98, 318, 166]. It is therefore suggested that many enrolments are from people who do not intend to participate fully, including professionals who want to gain understanding of the format to produce their own courses [79]. Casual, recreational learners may not wish to invest effort into attempting assessments that are generally used as test of knowledge of understanding and evidence of completion [133]. Lack of prerequisites and open entry encourage casual enrolment. Grover et al. [133] viewed this broad range of backgrounds, intention, and participation as 'a by-product of the open access nature of the courses and the novelty of the medium'. If users do not really intend to complete it, is argued that they should not be included in statistics, which may then be used as an indictment of the course [249]. A better measure might well be whether those who register achieve their own learning outcomes, as evidenced by the evaluation of the OLDS MOOC [79]; however, this is very difficult to capture and assess.

Lack of time: Students who fully intend to complete the course may fail to do so because they are unable to devote the necessary time to study [35, 69]. This has been noted even in courses where participants have a high level of motivation to complete it [48]. Personal circumstances may be to blame, but in some cases, the workload of the course may be too high. The diversity of learners' background means that the current 'one-size-fits-all' MOOC format does little to adapt to individual needs. Learning materials that are appropriate for some may take others much more (or less) time to master.

Course difficulty and lack of support: Similar to the previous point is the level of difficulty of a course and the lack of necessary background. Insufficient mathematical skills are noted in relation to the Duke bioelectricity course [35]. As one respondent in a survey said, 'The reason I stopped is because I cannot understand the issues being discussed any more' [197]. Student blogs often refer to the inadequacy of peer support and lack of instructors when topics become difficult.

Lack of digital skills or learning skills: Online learning generally requires a high degree of autonomy and depends on users being able to work with the technologies and formats used. Even those who are familiar with using a range of everyday technologies may be uncomfortable when new systems must be quickly mastered. Conole [69] pointed to learners' confusion and frustration as a reason for high dropout rates. In another scenario, the evaluation of the Duke biochemistry MOOC identified that students were unable to make the transition from theoretical learning to the practical application required for the assessments [35].

Bad experiences: Some MOOC participants have pointed to a variety of bad experiences as being a barrier to continued participation. These include inappropriate behaviour of peers in forums, lack of focus and coordination in forums, depletion of study groups due to attrition, poor quality and incorrect learning materials, and technical problems in the MOOC platform [48, 197, 336, 143, 144].

Learners' expectations and satisfaction: Students may enrol with little understanding of what the course requires and may have unrealistic expectations either of the course or of their own ability to undertake it. Learner satisfaction and meeting their initial goals in an online course fulfils and achieves the learners' needs. In an informal discussion with a MOOC user during a conference, the learner stressed that he registered for a course for a specific purpose, and after achieving his purpose, he dropped out from the course. He commented that this was fulfilment on his part for attaining his initial goals, desires, and aspirations. It is stated that some learners engage with online platforms and the content at their own pace. However, most of those who engage at their own pace are considered 'lurkers' who might not necessarily participate in the final quiz assessment, nor take part in the course questionnaires.

Starting late: Late starters on a course may find it very difficult to catch up and outcomes are likely to be much lower for these groups of students [336]. It is not simply a matter of catching up with learning materials. Support groups and learning networks would already have been formed and newcomers may struggle to fit into the existing structure. Students who join after community discussions are already well developed are often unable to orientate themselves in the forums [65].

Peer review: Some authors have noted that courses relying on peer grading often have much lower completion rates than others [154, 230]. Peer grading may well require more work on the students' part. It has also been suggested that some students are unhappy with the concept of peer review and that training is often lacking [133, 219, 18]. Other participants have been disheartened by bad practice discovered through peer review, for example, by unhelpful or dismissive comments on their work, lack of response, or discovery of plagiarism in peers' work.

Lack of confidence in the instructor is also seen as one of the issues for dropout. Section 2.6 presents effective approaches of a good practice in online and blended-learning pedagogy.

2.6 Aspects of Good Practice in MOOC Platforms

Technology has become a keystone for teaching and learning in the 21st century, with its use in education evolving at a rapid pace. The MOOCs concept has become a high-profile part of this trend, with many hundreds of courses now provided by many institutions and platforms worldwide. The rush to implement MOOCs has resulted in the lack of corresponding research, which is needed to understand areas crucial to learning, such as effective pedagogy and the learner experience [215]. There are many existing MOOC platforms aimed at achieving the same goals. However, there has been little discussion of the pedagogical rationale in the development approaches [282]. Such studies are now beginning to emerge, but there is still relatively little understanding of how MOOCs may be used to best effect in different contexts. There is a lack of published work on the incorporation of a MOOC approach as part of blended-classroom teaching. This section briefly reviews aspects of established good practice, which informed the development of our novel platform.

2.6.1 Pedagogical practice in MOOCs

Much e-learning development has focused on the development aspects and the provision of learning resources, rather than the instructional design needed to ensure effective pedagogical content [3]. As noted by Alexander [3, p. 240], 'successful e-learning takes place within a complex system involving the student experience of learning, teachers' strategies, teachers' planning and thinking, and the teaching/learning context'. Success of any e-learning course implementation requires careful consideration of the underlying pedagogy and how learners engage with the online content [124]. In most MOOC learning platforms, the main instructional tool is video mini-lectures. This approach has been criticised as a major misconception of how teaching works, with MOOCs from major providers not going beyond level 1 of Bloom's taxonomy [19]. Some studies indicate the success of certain, specific strategies within the MOOC context including providing incentives, such as badges, building activities around active learning, encouraging reflection and higher-order learning approaches, and providing contact with staff (generally in a necessarily impersonal form, such as weekly emails) [19].

Given the massive nature of such courses, pedagogical techniques must be scalable. Claims suggest that current MOOCs can replicate traditional teaching. Nonetheless, massive numbers of participants have been called naive, and the 'student-facing' positioning of the major platform providers belies the reality of the staff-poor information provision, which may be of benefit only to experienced or effective learners [325].

Moreover, MOOCs are lacking in some good virtual learning environment pedagogy. Some modern techniques and components exist, which will help improve the learners' experience when introduced into MOOCs. These modern techniques underpin the concepts, processes, and basic terminology in delivering the 21$^{\text{st}}$ century MOOC in a virtual learning environment. This study reviewed some of these modern learning techniques at the preliminary stages to see how the operations are applied. The main objective of this section was to illustrate some of the pedagogical approaches that enlightened the understanding of the selected components that were applied in the system design tool. Modern techniques have been applied in recent online learning environments differently from the MOOC setting. Many researchers have explored these techniques and features as the way forward in educational technology.

In a like manner, we investigated most of the methods of the course navigation and techniques in the study contributing to the findings in this research work. The next subsections explain the good practice techniques and present further discussion regarding some of the models or components involved. Some of the existing learning techniques are known to be socio-technical entities [119, 140]. Modern learning techniques are addressed in the following section, considering other factors that make the methods attainable. Some of these good practices in instructional pedagogy that are described in the next subsections were applied in developing the course platform tool used in this study.

2.6.2 Feedback

Timely feedback is generally acknowledged to be a major benefit in the learning process [19]. It is also noted as being related to the development of SRL since the cycle of action, evaluation, and reassessment benefits greatly from the input of reliable feedback [57]. In a MOOC, with potentially many thousands of participants and very few instructors, personal feedback and direction is problematic. Current approaches include automated feedback and peer review. However, there are difficulties with both approaches, and many MOOCs appear to offer extremely limited feedback. Moreover, MOOC users often feel lost and unsupported and express the view that there is insufficient help available [282].

2.6.3 Incorporating learning analytics

With the potential to collect and analyse large amounts of data from learning environments, learning analytics are now being used in a variety of ways, such as for the identification of students at risk of dropping out [281]. One significant role that learning analytics can play in the context of MOOCs is to direct more personal provision of feedback to learners. Given the importance of feedback, particularly to those who are learning in a self-directed MOOC environment, receiving timely, relevant, and personalised feedback and direction can help students evaluate their work, improve SRL, and increase motivation in general [11]. This is another area with good potential, but which is still in the early stages.

Learning analytics are a significant area of technology-enhanced learning and support for learners to decide and inform the instructor of their self-directed modes based on their navigating patterns [179]. Learning analytics are a technique to track learners' activities and event logs in an online learning system [165]. The analytics reveal the learner's pages visited, videos watched, and the duration spent on a course page. Google Analytics can show in real time the users' online activities and engagement with the course content and how each individual participant navigates within the course [149].

According to Grainger [126], learning analytics have a significant role to play in the future of higher education. One of the roles helps in guiding reform in education by assisting the educators in improving the learning and better delivery of the course content. This helps to support the improvement of SDL of the participants when the course is improved, based on their learning patterns, which could lead to learners achieving their personal goals. This can also be motivating and can encourage consistency in participation [159]. Learning analytics help the instructors to develop a better course platform and delivery as well as the participants to be motivated to further improve in their roles as learners in education [324]. This process of learning analytics helps in understanding the underlying rationale for the differences between individual concerns and values while studying [40].

2.6.4 Discussion forums

Discussion forums in MOOCs are the primary means of interaction among learners and instructors. Despite their widespread use, there is concern that forums are not an effective means of promoting engagement and learning. Discussion forums have been used as online interactive learning tools since the early 1990s and are intended to increase engagement, motivation, and reflection, thus leading to deeper learning.

Earlier studies have indicated that forums do not support learning as well as might be hoped [301] and that many students resist engagement. The rise of MOOCs has underlined the need to support collaborative learning [48]. Despite the concerns, forums have become one of the main tools in many MOOC platforms. However, the common MOOC model allows many thousands of students to each instructor, so forums also take on a major role in both peer-to-peer and tutor-led support. As more MOOC evaluation is conducted, patterns of forum use and issues relating to both social and educational expectations are emerging.

The learners' perspectives are also evidenced through learning blogs and the forum posts themselves. With large numbers of learners and few instructors, peer communication, support, and assessment are key elements of MOOC pedagogy. It has been claimed that completing learners are likely to have made more forum posts than non-completers, and forum posting has been cited as an effective measure of students' engagement [162]. Engaging in forum discussion, asking questions, and posting replies to others is considered an active and creative form of engagement, likely to enhance learning [105].

Schweizer's account of MOOC participation acknowledges the benefit of forum discussion for promoting reflection but expresses frustration at the general level of contribution as being 'unfocused, tentative, and frankly, misinformed' [272]. Course tutors use forums to provide course information, generate discussion, and support learners by answering questions. Brinton et al. [52] observed that active tutor participation increased the discussion volume but did not slow the decline in participation. In another instance, Yang et al. [336] used social network techniques to investigate forum posts in a Coursera MOOC and concluded that high post duration (time between first and last posts) was related to a lower likelihood of dropout in any given week, whereas being a discussion initiator or writing a high amount of posts was not. However, other studies provide contradictory evidence, as high levels of posting did appear to correlate with better course outcomes [148, 66].

Subsection 2.6.5 introduces a new trend in the concepts of blended-learning in a MOOC context. This describes the learning principles and aspects of self-regulation of learning by the students in an online blended-learning environment.

2.6.5 Concept of blended-learning in a MOOC context

At present, the technology used in university among students and lecturers in blended-learning has advanced into opening a new era of teaching and learning. The modern blended-learning environments allow educators to create in-house content to deliver courses to traditional face-to-face learners using free online open sources such as LMSs or to franchise with other existing commercial learning platforms. An example of such open LMSs commonly used nowadays in universities is the modular object-oriented dynamic learning environment (Moodle), which allows educators to upload and manage their online blended course and lesson content [304]. Bonk [44] mentioned some very interesting facts about open learning sources. First, the sources allow universities and other institutions to offer high tuition fee courses. Second, they produce more linguistic and cultural sources available to individuals with limited access to them. Third, they create like-minded communities to share ideas and knowledge among educators to help in improving other sectors.

The traditional educational system has been the foundation of education; however, the popularity of e-learning systems has led to several opportunities in directing self-learning. Thus, more institutions and universities are employing blended-learning instruction to manage the conventional way of teaching. The blended-learning environment is the combination of two different methods of teaching: one is the traditional face-to-face within the 'bricks and mortar' setting and the second is based on the online learning approach. The online blended-learning environment is an extension of face-to-face teaching, which provides an opportunity for students to continue their studies during after school hours, complementing their reading through thought materials and assessment exercises in a self-directed manner [276].

MacDonald [196] argued that the blended-learning approach has become imperative in a second language classroom, as this approach of teaching and learning combines both traditional methods and online applications in delivery course content to students. In addition, blended-learning provides wider benefits and scope for learning, enhances learning effectiveness among students, and lastly reduces the cost and time in obtaining quicker information and knowledge. Students in blended-learning classrooms must motivate and encourage themselves to attain their learning objectives. On the other hand, many factors encourage learning, but it has been noted that SRL influences and plays a vital role in students' academic attainment [245].

Similarly, as students decide their approach to learning using the resource materials, they develop the required skills to self-direct and regulate their learning behaviours. This process of students planning and regulating their studies is called SRL [96, 234, 42]. According to Zimmerman [350], self-regulation of learning encompasses the students' actions, thoughts, reflections, and feelings towards achieving individual goals. In a related study, Zimmerman [349] argued that SRL is imperative to the three popular aspects of academic learning: motivation, cognition, and behaviour.

Zimmerman [347] classified these three characteristics of SRL as follows. First, the study mentioned that self-regulation of behaviour encompasses the full control of the learning resources for the student use, which, in this case, encompasses learning time, environment of study, and support from tutors and peers [237]. It has been noted that, if perceptions of self-regulation in regards to good behaviour are managed effectively, this will enable learners to improve in their patterns of learning to attain better academic performance [163]. Second, self-regulation of motivation comprises the process of controlling and changing motivational beliefs, for example learners changing their self-efficacy and goal orientation to fit into the requirement of the course to achieve optimum academic success. In addition to this, students could improve in the skills of controlling their emotions and anxiety to promote SRL skills. Last, self-regulation of cognition involves the autonomous control of several cognitive strategies used for learning, such as the application of deep processing strategies that enhance effective academic performance and learning [114].

According to Cleary and Zimmerman [64], the ability of students to regulate their learning approaches is the key to succeeding academically and beyond. Several studies have been done on successful learning and on the design of new learning environments, which have attributes, such as learning skills, knowledge, and behaviours associated with attaining SRL [157]. Moreover, SRL depends on the learners' ability and readiness to engage in a learning process by stimulating new motivational strategies to maintain their emotions, thoughts, actions, and beliefs to achieve their set goals [221]. In this case, learners set specific learning goals in relation to the task that should be completed, considering the characteristics and requirements of the task. Kreber et al. [171] argued that to attain success in each task, learners should take full control, monitor, and regulate their cognition abilities, emotions, and actions.

This study proposed to investigate the process of SRL, which was observed from a preliminary exploration conducted on two distinct learner population samples. Section 2.7 presents an extensive discussion of SRL habits, the two popular models: Zimmerman's model and Butler and Winne's model, some of the instruments applied in measuring SRL skills, and the six existing dimensions or strategies adopted in this study.

2.7 Self-Regulation of Learning

This section presents previous research relevant to the current activity, covering SRL and its conceptualisation for online contexts and the current thinking on aspects of good SRL practice among learners in online learning platforms.

2.7.1 Self-regulated learning

Self-regulated learning refers to the ability of the learner to plan beforehand the pattern of his or her study approaches before engaging with an online course. The learner draws a map of what to achieve and sets effective goals to accomplish at the end of the course [163]. Effective learning refers to tactics in which the students enthusiastically participate by 'doing' rather than inactively listening. It has long been associated with improving accomplishments, particularly in science, technology, engineering, and mathematics (STEM) subjects [111, 150]. The passive nature of most MOOCs means that students' options for effective engagement are inadequate, their interest may be lacking, and dropping out is more probable [1].

In addition, the rigid structure of most MOOCs takes away all control from the learning, leaving a content-centred, linear course in which the instructors set all the goals. The ability for learners to take control of their own learning habits (for example, by setting their goals, developing learning approaches, organising task strategies, and self-reflecting) is one feature of SRL, and effective self-regulation is associated with enhanced learning and better retention [348, 352]. An effective e-learning course design can encourage learner autonomy by empowering students to set out goals and plan a route to achieve them [80]. Autonomy is characterised in e-learning as freedom of movement by the learner within the studying environment, 'without concern for predetermined order or sequence' [208].

Lack of self-regulation skills may prevent online learners and blended-learning students from achieving expected learning outcomes [334, 29]. Most MOOC systems currently support less autonomy and lack the promotion of SRL. Self-regulated learning often revolves around the assumption that individual learners could act as an agent for their own learning patterns [30, 31] and make choices that will suit them and be beneficial to their learning objectives and goals [201]. In this study, we presume that participants should have high self-regulatory skills, as most of the participants in this investigation are highly educated, experience professionals, or postgraduate and undergraduate students. Therefore, they are expected to be confident in exploring new ideas to extend their knowledge and expertise by following their own chosen routes to learn [236]. Equally important to note is that self-efficacy, like many areas of SRL, is context dependent and relies on the previous knowledge and experience of participating in MOOC learning, which could be imperative in enhancing better academic performance [215, 195]. Chang [58] illustrated how conducting the required training in various aspects of self-regulatory strategies could lead to advancing support for self-efficacy in the context of online study.

Furthermore, with this new trend in MOOCs, efforts should be put in place by course developers to train learners on how to tackle the challenges encountered during individual SDL mode. Equally worthy of mention is that, as demonstrated by some authors, motivation, self-regulation, tenacity, developing a good attitude towards a learning process, and finally the feeling of self-confidence and full acceptance are only some of the many psychological factors influencing academic performance and attainment [94, 50, 300].

Learning is known to be an individual construction, which emerges in a unique process that comprises the various aspects of interacting with the course resources, interacting with the learners in the forums, and interacting with the course instructor(s) [50, 279]. Similarly, Bandura [21] argued that an online study shows that self-influence habits greatly motivate human behaviours. This argument seems to be related to learners developing the ability to motivate their study habits. Self-regulation, on the other hand, encompasses the mechanism of self-efficacy, which plays a central role on the major effect of the learners' thoughts and actions to motivate them during engagements [23].

In related studies conducted by Bandura [22, 20, 24], the study argued that social factors influence the self-regulative mechanism in a learner. Self-regulated learning has been mentioned to be a factor for improving learning outcomes either in face-to-face or online settings. Several studies have proven that students who regulate their learning perform better than those who do not or are less able to regulate their learning [163, 349, 355]. Self-regulated learning has been described as the wishful ambition of the result outcome of the process of learners' self-regulated beliefs and manners that are systematically oriented towards their attaining and achieving their learning goals [355, p. 125].

Comparatively, learners who are more autonomous in learning are said to be better self-regulators, as compared to those who are less autonomous. According to Moore [216], autonomous learners can take and improvise control over their learning instead of being dependent on the instructional content to attain their learning goals [24]. In another instance, studies described students who engaged in more online self-regulatory activities were associated with better academic outcomes and retention and show a more positive perception of online course satisfaction [147, 108].

2.7.2 Definitions of self-regulated learning

One of the main areas in which self-regulation has been greatly influential is education. Self-regulated learning refers to the process by which a learner takes control of, directs, and evaluates his or her own learning [57]. It encompasses dimensions of metacognition (reflection on one's thinking), strategic action (planning, monitoring, and evaluating progress) and the motivation to learn. A wealth of studies conducted over 30 years have discovered a strong link between high self-regulation and effective learning: self-regulating learners learn best [57, 355, 350]. Definitions of the concept of SRL have been expressed in slightly different ways by various authors. For example, Paris and Paris [229, p. 89] stated that SRL 'emphasizes autonomy and control by the individual who monitors, directs, and regulates actions toward goals of information acquisition, expanding expertise, and self-improvement'. Zimmerman and Schunk [355, p. vii], viewed SRL as an approach that 'seeks to explain how people improve their performance using a systematic or regular method of learning'.

In practice, SRL requires effective mastery of a range of skills generally acknowledged to include goal setting, task strategies, help seeking, environment structuring, time management, and self-evaluation. Yet, when defining SRL, it is imperative to distinguish it from self-regulation processes, such as self-efficacy, and strategies that are created to optimise the learning processes [28, 29]. These may be broken down further into explicit, concrete aspects, for example, a student's effectiveness at environment structuring can be investigated by exploring whether they identify a distraction-free working environment for their study sessions, whether they are aware of what study environment suits them best and choose accordingly, and so on. Some learners may implicitly recognise the need for SRL skills and demonstrate facility in developing and deploying them. More experienced learners and those who already have a background of academic study and achievement are more likely to have internalised and automatically put into practice appropriate SRL strategies that are effective for them [349]. The aspect of metacognition is important here since self-awareness of what works for oneself guides selection of the most suitable strategies [57]. However, for many learners, explicit development of SRL skills, both early in their learning process and as an ongoing process is highly beneficial. A variety of research-informed approaches to develop SRL skills have been documented [357].

2.7.3 Self-regulated learners

Self-regulated learning allows learners to approach educational tasks with confidence and diligence in a resourceful manner. Zimmerman [348] explained that self-regulated learners are knowledgeable and aware of when they are confident on a fact and when they possess the skills to execute and resolve the task successfully. Additionally, they are aware of when they do not possess the ability to resolve a task. However, unlike passive learners, self-regulated learners are proactive when seeking out the necessary information needed to succeed and then further instigate personal steps to master the resources. Equally, self-regulated learners can find a way out of most obstacles during their studies and learning processes to succeed. In a similar manner, self-regulated learners view learning acquisition as a systematic and controllable learning process. Self-regulated learners further accept all responsibilities for their attainment and learning outcomes [46, 354, 348]. Self-regulated learners are self-starters with extraordinary confidence, and they are persistent during their studies. The learners create structured learning environments that help them optimise their learning approaches [139, 321, 354]. These self-regulated learners seek out sufficient information and advice on places for which they are most likely to concentrate and learn effectively. Theories have proposed that self-regulated learners 'self-direct their knowledge acquisition and self-reinforce during performance enactments' [348, 90, 254].

2.8 Conceptual Illustration of SRL Models

This section describes two major models relating to some of the SRL strategies used in this study. The two selected models are 1) Zimmerman's model and 2) Butler and Winne's model, as described in subsections 2.8.1 and 2.8.2.

2.8.1 Zimmerman's model of self-regulated learning

According to Zimmerman and Moylan's approach [353], the cyclical model of SRL describes how the stages or phases of self-regulation such as, performance, self-reflection, and forethought, interact (as seen in Figure 2.3). In fact, this model is used in this thesis to emphasise that SRL strategies are an imperative and integral part of SRL. Likewise, due to the interwoven nature of these SRL strategies, failing to properly define one could lead to impairing other phases or strategies [13].

In summary, Zimmerman and Moylan's model, which describes learner goals, has been central in all phases of the model [353]. In the performance phase, keeping the goals in mind helps in improving the motivation and supports learners to review their progress towards attaining their goals. In the self-regulation phase, the learners observe their performance with the plan goals that influence self-efficacy, self-judgements, outcome expectations, and task interests towards goal orientation. In the forethought phase, the learners analyse the values of their tasks by goals. In addition, outcome expectations are described as the learners' beliefs in success. For the learners' outcome expectations to be attained, specific factors should be considered.

The task value in the model defines the value of the learner's individual goals. Similarly, goal orientation prompts the learners' motivation to engage with the learning resources. In conclusion, Zimmerman and Moylan's model is developed in a cyclical form, such that the self-judgement strategy in the self-reflection phase influences self-efficacy, outcome expectations and task value in the forethought phase, which shows the associated strategies and how each of the strategies are related [13]. In the forethought phase, goal setting and strategic planning in the task analysis strategy are related to the task strategies and environmental structuring in self-control, and the cyclical loop continues, as seen in Figure 2.3.

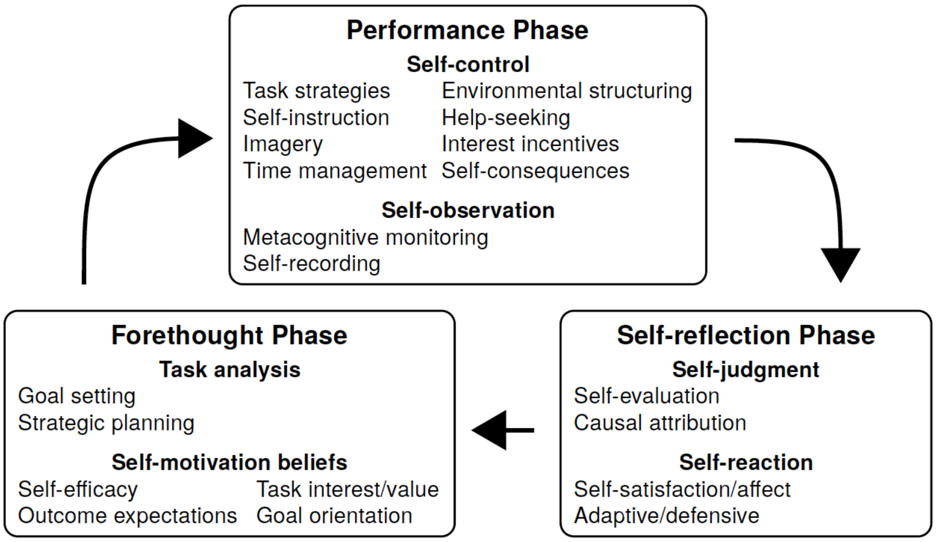

Figure 2.3: Zimmerman's cyclical model of self-regulated learning, excerpted from Zimmerman and Moylan [353].

2.8.2 Butler and Winne's model of self-regulated learning

Butler and Winne [57] categorised their SRL into phases, such as student interpretation of their task requirements, based on their prior knowledge and beliefs. Likewise, the learners set goals and applied tactics and learning strategies, such as mental and behavioural strategies, to meet the task requirements. The learner reflects on his or her learning progress, which in turn leads to self-reflection on the internal feedback received, which would lead to subsequent engagement [13]. In a more concrete description, Butler and Winne [57] defined the monitoring process as a cognitive activity that expands the process of learning towards goal attainment and produces internal feedback to support the direction of future learning paths.

Another interesting point raised by Butler and Winne [57] is that information about specific events, for example, strategies, tactics, and goal setting can act as a cue; therefore, any feedback related to the sequential events in relation to performance could trigger improved calibration in a learner's progress.

In summary, Butler and Winne's model proved that the function of feedback in the study was to inform. This could take place concurrently during learning for the learners to readjust their initial planned tactics and strategies, which could enhance their learning outcome. They argued that, with this process, the SRL of the learners could be improved with the help of external feedback, which could support or enlighten them regarding the proper interpretation of their performance. In this case, the feedback should be designed in such a way that it will help the learners merge the understanding of their performance with the exact outcome performance. This will help to improve calibration, as seen in Figure 2.4.

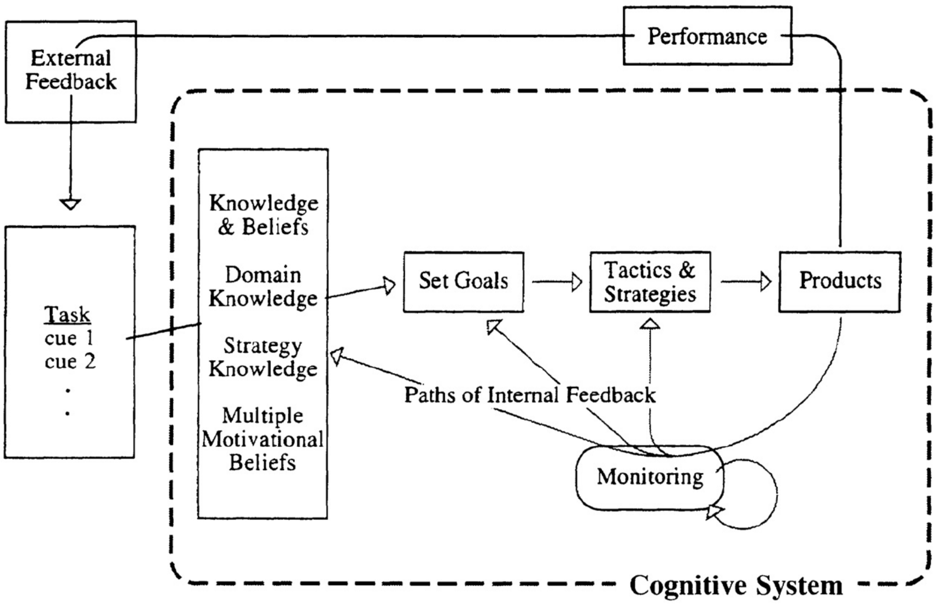

Figure 2.4: Butler and Winne's self-regulated learning model, excerpted from Butler and Winne [57]

2.8.3 Self-Regulation in online learning

When studying online or at a distance, SRL skills are likely to be even more important, given factors such as the greater need for learner independence, the lack of imposed structure for study times, and the need to determine one's own study environment. Students who engage in more online self-regulatory activities are associated with better academic outcomes and higher retention and show a more positive attitude in online course satisfaction surveys [147, 108]. Conversely, lack of SRL skills is observed to prevent online learners from achieving expected learning tasks [29].

The strategies learners need to deploy to achieve effective SRL are likely to be highly context dependent [355]. Hence, there will be differences between the skills needed in a 'traditional' learning models and those required in an online learning environment (and between different online environments). Hence, approaches needed to support learners in their development of SRL skills for an online context may overlap to some extent with those used in a traditional setting, but there will also be significant areas of difference. Some studies have sought to develop training tools that are specifically suited to online learners (and are themselves presented online) [82]. Evaluating the effect of incorporating appropriate SRL skill training in an online course, Chang [58, p. 217] noted, 'Students learning within a web-based environment with self-regulated learning strategies became more responsible for their own learning, more intrinsically orientated and more challengeable. They tended to value the learning material more and became more confident in course understanding and class performance'.

McManus explored differentiated learning approaches, finding that students with good SRL skills do not learn effectively within a strict, linear course structure [208]. Conversely, students who are not effective self-regulators do not learn well in a highly nonlinear course where they are confronted with too many choices. The right level of autonomy in an e-learning course can empower students to develop SRL skills, such as setting goals and planning a route to achieve them [80]. In an autonomous course, learners can take control over their learning instead of being dependent on a fixed instructional path and passively consuming given content [216], but sufficient existing SRL skills are needed to leverage this [208].

2.8.4 Self-regulation in MOOCs

In most MOOCs, the structure is highly linear, and the teaching style is 'top down' with content laid out by subject experts. Attempts to provide support, feedback, and social contact are often made through activities such as forums and peer reviewing. In the context of the MOOC format, it is likely that a distinct range of SRL skills (and a high level of such skills) will be needed. Indeed, it is hardly surprising that most participants in MOOCs are found to be highly educated, mature, experienced professionals with one or more existing degrees [2]. Such learners are generally confident in exploring new ideas to extend their knowledge and expertise by following their own chosen learning paths [236]. However, the rigid structure of most MOOCs takes control away from the learner, leaving a content-centred, linear course in which the instructors set all the goals. Further, the passive nature of most MOOCs means that students' options for effective, active engagement are inadequate; their engagement and interest may suffer, making dropping out more probable [1].

Despite the need for SRL skills to achieve success in a MOOC, many such courses do not appear to have been constructed with any idea of building in support for fostering these skills, either implicitly or explicitly. Although MOOCs are open to all, they often fail to cater to the variation of SRL levels that might be found among a wider range of participants, with those who do not possess the required levels of SRL skills feeling lost and failing to progress [62]. There is thus a need to ensure balance between the support and direction that some users will need, while allowing effective self-regulating learners to control their own learning and set appropriate goals as much as possible [32]. Given that effective self-regulation is associated with enhanced learning and better retention, it is surprising that little attention has so far been given to this in the context of most MOOCs.

2.8.5 Self-regulation indicator for MOOCs

Littlejohn et al. [187] proposed indicators that included the various skills related to self-regulation of learning, which they mentioned as being essential for online courses such as MOOCs. These skills are generally important for learning when incorporated in MOOCs [92].

In addition, these individual SRL skills are essential as an important factor in the design of a learning platform [134]. Littlejohn et al. [187] focused their attention on self-regulation required for professionals and highly skilled learners in their MOOCs. However, this also provides a vital tool for motivating SRL in the MOOCs in general. The study shows the need for instructional designers to question their design principles and provide interventions that could improve course platform design in MOOCs, which could also be adapted in other contexts or in reverse engineering contexts for example, in blended MOOCs. In another study, they presented a new set of design principles based on learner perspectives. The argument focused on empowering learners in their various environments and networks to foster individual critical thinking and collaboration to develop competent outcome results and to encourage peer-to-peer assistance, providing tools and strategies for self-regulation [134]. Leris et al.'s [182] first indicator focuses on the promotion of skills that are associated with self-regulation of learning, while the others are related to cooperative learning skills, which are considered necessary aspects for improving participants' motivation in MOOCs, which is believed to decrease dropout rates.

2.8.6 Self-directed and self-regulated learning

Research has shown the importance of SDL and SRL in learning. These terms are increasingly being used in both online learning and traditional settings. However, the similarities and differences have not been fully harnessed. The most renowned definition of SDL comes from Knowles [164] who described the term as a process from which an individual takes initiative with or without help in autonomously controlling their learning with regards to needs, setting learning goals, identifying resources for learning, deciding on appropriate learning strategies, and self-evaluating their learning outcomes. This SDL process is said to be a personality trait and construct [54].

Brockett and Hiemstra [54] proposed a term called ‘self-direction in learning’, which referred to external characteristics of an instructional process and internal characteristics of the learners assuming the primary responsibilities of directing their learning experience. Similarly, to SDL, SRL ‘has been considered students’ independence in learning’ [260, p. 191]. Moreover, SRL is said to be an active process whereby learners set goals during their learning process and attempt to regulate, monitor, and control their cognition, behaviours, and motivation and are guided by their goals and environments [237, 43]. Furthermore, SRL is perceived as a learning and motivational processes that underpins learners’ assumption of individual responsibility to learn with or without an instructor [350]. The SDL and SRL concepts activate metacognitive skills and intrinsic motivation, which are the key components in both cases [193]. Both these terms are featured as a combination of internal and external factors. Motivation, metacognition, and cognition factors represent SDL, while SRL involves traditional learning processes, which involves human collaboration [61]. Some reasons that these terms are being used synonymously are that ‘the personality perspective being the overlapping part of both constructs’ [260, p. 192].

In contrast between the two terms (SDL and SRL), the first concept originated from adult education in the 1970s to 1980s, whereas the second originated within the 21st century from educational psychology and cognitive psychology. Additionally, SDL is mostly used to describe learning activities outside of the traditional educational setting and involves aspects of designing learning environments [260]. While SRL, in this case, is mostly studied in a school environment, it should not exclude the possibility of designing a personal learning environment [193]. Moreover, SRL has been considered a broader construct, encompassing concepts that are specific to a narrow area. Furthermore, SDL is also seen as a broader concept in the sense of exhibiting control and freedom by learners to manage their learning activities to a degree. In SDL, the learners decide and define their learning tasks, but in SRL, the instructor may also define the learning tasks [250, 193]. Jossberger et al. [156] mentioned that SDL is situated as a macro-level concept and that SRL is a micro-level concept (as seen in Figure 2.5). A self-directed learner is actively ready and willing to prepare, execute, and complete a given task independently and on time. The ability of the learners to learn how to self-direct their studies is a skilful way of self-regulating learning activities and performance. In addition, SRL is a micro-level concept, which is processed within and during the task execution. A study argued that SDL may include SRL but not the opposite. In other words, self-directed learners are supposed to self-regulate their learning, but self-regulated learners may not necessarily self-direct their learning [156]. However, despite their similarities, the theoretical models, backgrounds, and dimensions are different. In comparing research methods applied to these terms, SDL is mostly studied with surveys and case studies, while SRL is studied using experiments and surveys [260].

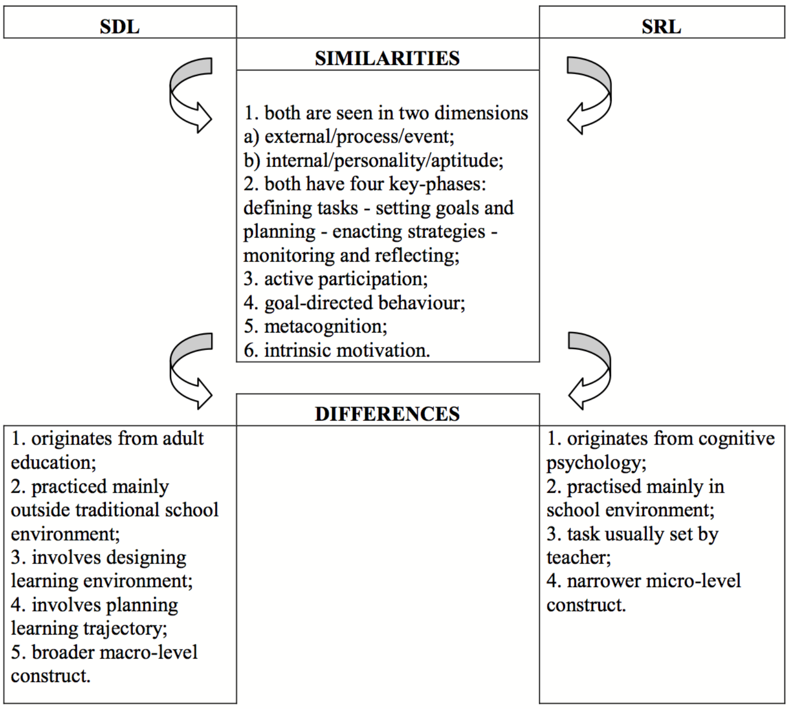

Figure 2.5: Similarities and differences between SDL and SRL, adapted from Saks and Leijen [260]

2.8.7 Instruments to assess self-regulated learning

To evaluate students' levels of SRL skills, a suitable approach or instrument is needed. Zimmerman and Pons used semi-structured interviews in which students were presented with a variety of learning contexts and asked what strategies they would use in each one [354]. This is a good way of obtaining rich data and generating new hypotheses, but it is not a practical means of assessment for courses with large numbers of participants, particularly online ones. An early, influential survey instrument, the Motivated Strategies for Learning Questionnaire (MSLQ), was developed by Pintrich et al. [238]. This self-reported, Likert-scale instrument was designed to assess student motivation and use of learning strategies and has been widely used in other studies. A specific Self-Regulated Learning Inventory (SRLI) Instrument was introduced by Lindner and Harris [185] and uses a similar style of question. A review of SRL assessment for classroom teaching conducted in 2000 indicated that surveys, interviews, teacher assessments, and talk-aloud walk-throughs were all commonly used [330]. Given the contextualised nature of SRL skills, an appropriately targeted instrument is needed for online and distributed environments.

To assess SRL in an online context, Barnard et al. [29] developed a survey instrument that captures a conceptualisation of SRL on six separate dimensions: environment structuring, goal setting, time management, help seeking, task strategies, and self-evaluation. This instrument, known as the OSLQ, explores each of the six dimensions using between three and five questions. The survey instrument employed in the current research is based on the OSLQ, adapted to the MOOC context. The original authors conducted the validation of the survey instrument used to investigate this research [28, 29].

Barnard et al. [29] developed the instrument to measure self-regulation in an online and blended-learning environment. They mentioned that the OSLQ instrument was an acceptable measure for the SRL skills of their blended-course students. In another instance, students' SRL ability was measured using an instrument known as the MSLQ [238]. They presented their instructional materials in six different ways, organised into categories of three levels of nonlinearity: low, medium, and high. The students' knowledge was measured using a test comprising multiple-choice questions. Finally, the results indicated that, within the high nonlinearity of their presentation, the instrument reveals that low self-regulated learners performed better than both the medium and high self-regulated learners. The last result initiated an argument that this could be because of the manner of measurement in which the students were classified into different levels that might have affected the performance levels of the learners' self-regulation of learning.

The results are similar to the findings in this study after using the adapted MOOC OSLQ (MOSLQ) for the blended-classroom course. The results also revealed that the students in the blended experiment showed low SRL skills in all the dimensions, which classified them as low self-regulators. On the other hand, they performed very well in their weekly assessments, as discussed in Chapter 7. In another study, a survey was conducted on 58 students, which shows two self-reported learning inventories. Ertmer et al. [102] used MSLQ and SRLI to measure the efficacy, self-regulation, and the motivational levels related to student learning. In Williams's study, previous research claimed, 'that students' confidence and motivation levels increased as they became acquainted with problem oriented learning' [327]. In contrast, studies have shown that self-regulation was specific to context [349]; however, an instrument that is valid in an orthodox classroom-learning setting, for example, MSLQ proposed by Pintrich et al. [238], could become unacceptable in an online learning environment, given the drastic variation between the two learning processes.

During this research, similar to one of the instruments mentioned [29, 28], this study conducted an OSLQ to measure the learners' SRL skills. This research instrument measurement was conducted based on an existing OSLQ technique, which was modified to suit these research objectives.

2.8.8 Six dimensions framework used in constructing the research instrument

The instrument for this research study is categorised into six distinct dimensions: goal setting, task strategies, time management, environment structuring, help seeking and self-evaluation, as illustrated in Figure 2.6. This research uses the framework of the six dimensions [28, 29] in constructing the OSLQ instruments. We adapted the same six dimensions to form the framework in creating the new modified OSLQ instrument for this study's data collection processes in both case studies (full online course and the blended-classroom setting).

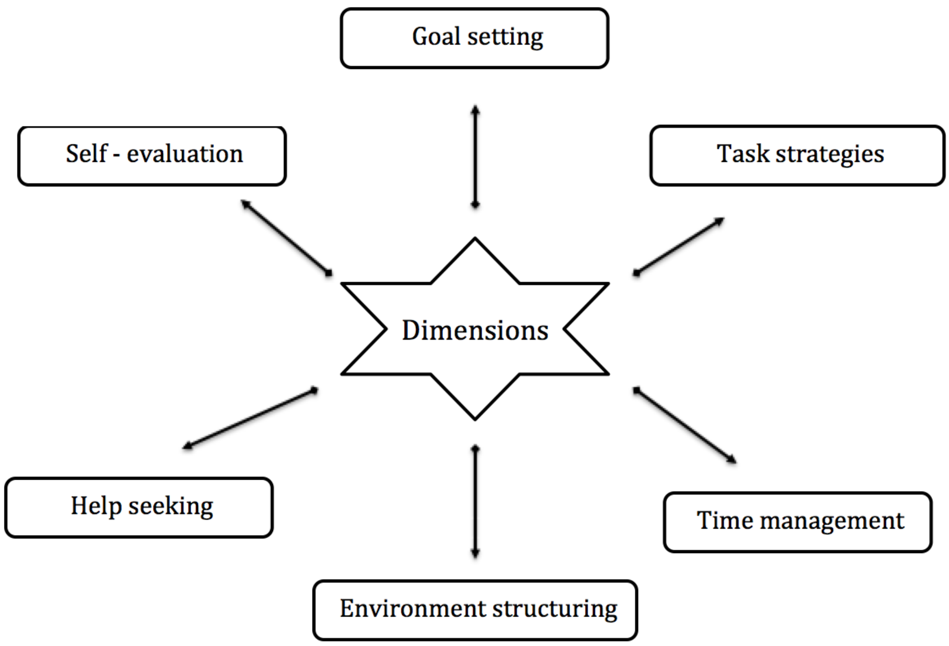

Figure 2.6: Framework of the six dimensions used in developing the instrument [28, 29].

Goal setting: Goal setting is the process of setting a specific agenda that will help learners in identifying their desired outcomes to achieve in the given task [189]. It can also be described as the explicit cognitive abilities of a distinctive participant's SRL skills that are unique to each of the learners in the learning environment. The participants at this point plan individual aims that they work towards achieving.

Task strategies: Task-specific strategies help learners to reflect on their studies because at the end, each learner will then review whether they can achieve their planned task with the strategies used. In addition, self-instruction as discussed earlier is the strategy that supports participants in directing their studies and reflecting during their learning processes [13].

Time management: Another very useful strategy is time management. This strategy requires sufficient skills for the participants to be able to prioritise their learning time and not be distracted into spending their time on other activities. For effective outcome results, the participants need to devote much time to their studies.

Adequate time is essential to arrange the type of learning environment needed for effective studying and to achieve the set goals.

Environment structuring: This strategy tends to follow implicit behaviour, as discussed earlier. For example, avoiding distracting locations is one step in determining the learning environment [28]. Self-regulated learning has been described as the ability of the learners to exercise absolute control over their learning behavioural patterns and their chosen environment [22].

Help seeking: Seeking help is another useful support strategy in this instrument. However, in this study, not much of it was seen from the learners' perspectives. This strategy assists learners in gaining external and internal assistance from either their peers or the academic tutors in areas that they found difficult to understand. Research has shown that this strategy improves and enhances the confidence of students with low abilities.

Self-evaluation: In brief, self-evaluation is the process of reflecting and assessing activities using the learner's initial set goals [13]. The learner evaluates whether their set goals were achieved at the end of the course. This strategy helped the instructor to understand whether the learners' aim was to perform better and complete the course or just to obtain the satisfaction of a specific area of interest.

2.9 Summary

In summary, this literature review chapter has highlighted the relevant research areas that have been explored to explain the broad scope of the research reported in this thesis. This chapter showed the main research gap by presenting an extensive theoretical foundation and history to examine the area that provides the focus for further exploration, by investigating the various gaps discovered in the related literature, and exploring the focus of the main contribution in this research. Some of the gaps observed in MOOCs are related to the following. (1) Low completion rates have been mentioned as one of the most prevalent deficiencies in the MOOC system. Another drawback was in terms of the effectiveness of the existence of best MOOC practice. (2) The other problem mentioned in the literature was that it lacks structure and that good instructional practice is lacking. Learning analytics have shown the various course units that need improvement [110]. This facilitates a better course delivery. The use of learning technology as a catalyst towards enhancing the learning process for learners in educational contexts thus involves an investigation of the learners themselves and the content which they have engaged in this context as well as the learning platform environment and the components that comprise this environment.

The MOOC innovation has led to the expansion of education and learning around the globe. The issue of high dropout rates has been identified in the literature as a major factor hindering and affecting the broad acceptance and usefulness of this emerging trend in learning. This thesis has presented the investigation regarding the main theoretical framework on how learning motivation could be enhanced both from the learners themselves and by using a design science paradigm to support learning. The study aimed to understand MOOC learners' SRL strategies in a design-based research study and presented students' motivation and independent activities that influence their learning strategies. Finally, an extensive review of the theoretical framework of the research SRL investigation was presented. The implications of SRL conceptualisation from the perspective of online learners and blended-learning students were addressed.

Chapter 3

Methodologies

This chapter describes the research methodology in this thesis. We present a DSRM as the overarching research approach and the method used for the development and implementation of the system. The chapter also presents the research design frameworks, the methods applied to the data collection processes, and the analysis of the data throughout the entire research, and a summary.

3.1 Aims of the Research

All research comprises underlying principles, which constitute invaluable research methods appropriate for contributing to knowledge in a research study. We discuss the design methodology and the design strategies underpinning the new features introduced in this research. The eLDa platform used as the tool in this research is to enable the investigation of the various modes of learning in this study. The idea behind the learning tool platform is to help investigate learners' SDL and instructor-led learning. Design science principles were used to develop a tool to achieve the aims of the research and support learners in directing their choices and developing the ability to initiate SRL skills.

The initial MOOCs have suffered from two major problems: 1) high dropout rates (around 90%) [85] and 2) low completion rates, as discussed earlier in Chapter 2. This research seeks to investigate methods of mediating and mitigating these issues of massive dropout rates by providing incentives and support to encourage participation. According to Zapata-Ros [345], existing MOOCs lack instructional design and methodology that makes MOOC integration into research, where grades are used as the dependent variable, difficult.

The research introduced an emerging novel learning technology known as eLDa with an instructional approach using the design science methodology. The novel platform is the tool for answering the research questions and objectives. This tool is also applied to support the theoretical framework in this study and is designed as the tool to investigate SRL and the various patterns of learning observed among the participants. The general idea was to help to motivate participation, mitigate the problem of low achievement in a MOOC, and expose areas of SRL that need improvement. The overall goal of the tool is to incorporate and analyse the effects of novel features to improve motivation in learning and to support self-regulation.

3.1.1 Research process

This section addresses the various processes used in coordinating this research. The systematic approaches are explored to complete the study. Figure 3.1 visually presents the complete research process aiding this research investigation.

Figure 3.1: The complete research process.

3.2 Research Methodologies Applied in This Study

Online research shows that self-influence habits greatly motivate human behaviour [21]. Self-regulation encompasses the mechanism of self-efficacy, which plays a central role in the learners' thoughts and actions in directing their course engagements. Social factors influence the self-regulative mechanism in a learner. The next section presents the research methodologies applied in this study. This chapter addresses both the theoretical framework and the procedure of information gathering to answer the following research question:

6. What are the implications for MOOC pedagogy to foster SRL?

This research study is classified as interdisciplinary research with pedagogical theories from educational technology and computer science. A mixed methodology has been selected for the research data collection process. The theories and methods were drawn from 'designing and conducting mixed methods research' [63]. Figure 3.2 illustrates the various methods applied in this research process.

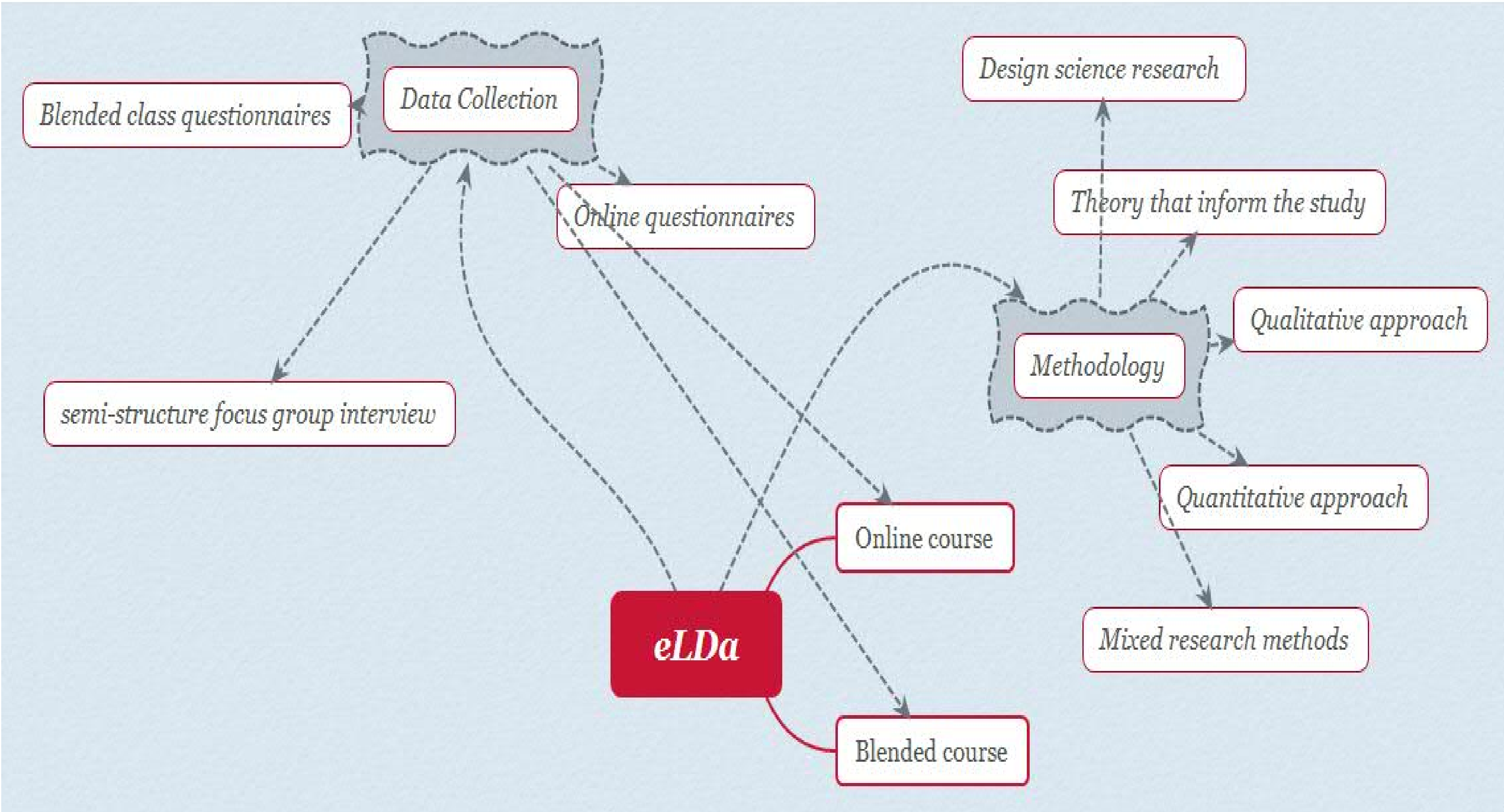

Figure 3.2: Research methodologies and data collection processes.

3.3 Design Science Research Methodology (DSRM)

The overarching methodology for this study is that of DSRM. Von Alan et al. [316] classified design science research (DSR) as a method that extends the boundaries of both organisations and humans by designing new innovative artefacts. This paradigm centres on the development and evaluation of an artefact to investigate a precise problem or problem domain [327]. The methodological approach involves six steps: problem identification and motivation, definition of objectives for a solution, design and development, demonstration, evaluation, and communication [232]. The design science paradigm involves two major processes, which are (1) developing and (2) evaluating new artefacts. First, the developing process results in the design of a new innovative system that attempts to solve a specific problem domain. The artefacts can be simulated models, constructs, approaches, and techniques. Second, the evaluation process involves the accessibility, consumption, and utility of these design artefacts. The evaluation process could include empirical research methods, mixed methods, qualitative methods, and quantitative methods [211].

In our case, the eLDa platform and trial course constitutes the artefact constructed using design science ideologies. Figure 3.3 demonstrates the flowchart of the complete structure of the overarching research methodologies that were applied in this study to investigate, analyse, and present the findings from the collected data evaluation and evidence.

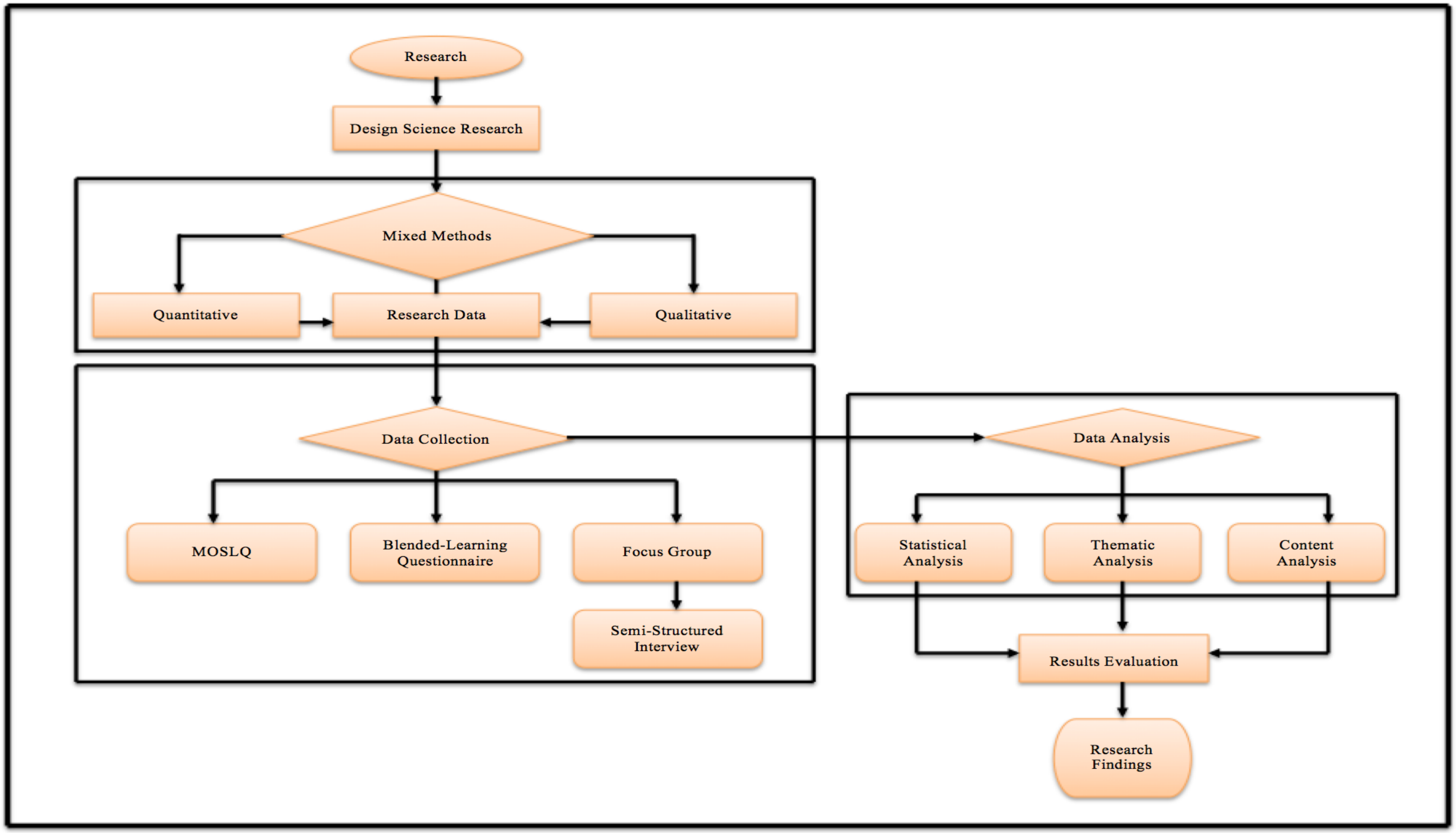

Figure 3.3: Flowchart of the research methodology.

3.3.1 Design science research framework

Von Alan et al. [316] described an improved DSR framework that emphasises the interaction between various environments or platforms, the DSR process, and the acquired knowledge base that informs the theories and methods of the design artefact, as seen in Figure 3.4. March and Smith [199] argued that design science needs to be processed from two main cycles, which are (1) the build cycle and (2) evaluation cycle. This study shows that the build process illustrates the design of the artefact. The creation of the prototype design is done through these five processes: constructs, models, methods, products, and instantiations. They describe all these deliverables of the DSR as follows: the construct process is an elementary aspect of the problem to be solved. The models are only related to the relevant constructs to be used in the preliminary design. The models are similar to the theory of the research problem area. The methods used in DSR specify the design principles to perform the task. The product of the task will then result in the developed system. Finally, the instantiations (according to Venable [313]) are the realisation of the first stage of the physical design, abstract, or the pilot system, which could be tested and evaluated before applying it in the real world or real-life scenarios.

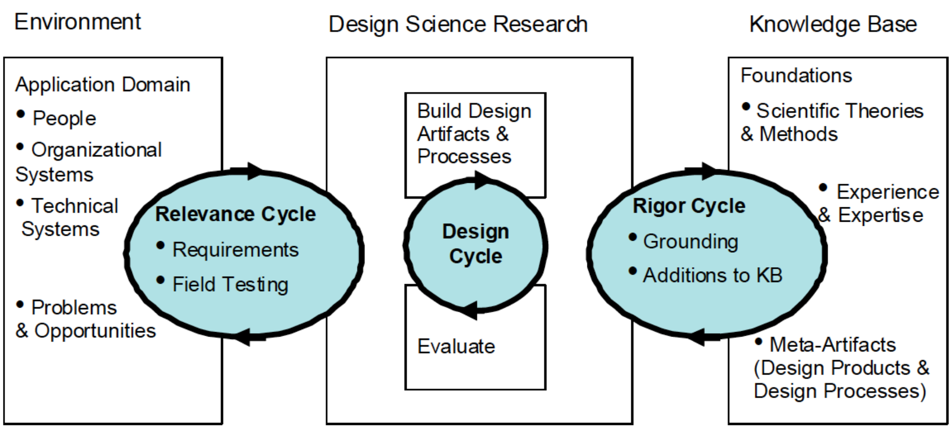

Figure 3.4: Design science research cycles (Von Alan et al. [316]).

In another study, for instance, the framework for DSR activities has been developed and contextualised in the information system research as proposed by Nunamaker Jr et al. [222]. The authors were mainly concerned with the instantiation process of the information system. Their research framework concentrated on four areas of research activity, which include (1) theory building, (2) system development, (3) experimentation, and (4) fields of study (as illustrated in Figure 3.5).

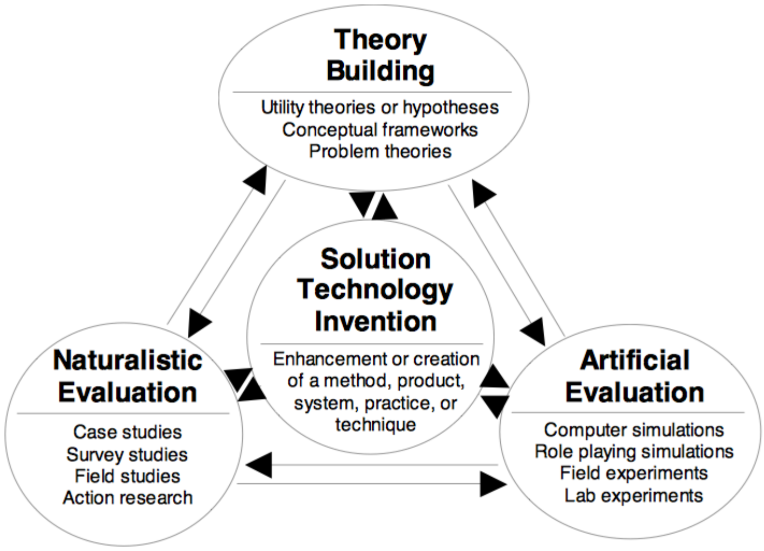

Figure 3.5: Framework activities and context for design science research adapted from Venable [313]; Nunamaker Jr et al. [222].

3.4 Mixed Methods

Mixed research methods are used to gather a range of different types of data using different research approaches. A mixed methods approach of collecting the data should evolve from the investigation. This study applied mixed methods of qualitative and quantitative approaches in gathering the data [68] because of the distinctive approach of gathering a range of different types of data, which are required to be collected using different methods [202]. The selection of the methods used in this research depends on the research objectives and on how the various concepts are defined.

These data are being collected from two different learning case studies: a full stand-alone online course and a blended-learning course. Therefore, to choose the appropriate data collection methods using the combination of qualitative and quantitative approaches, an inward reflection of the research questions was conducted regarding whether these could be answered using both types of data approaches. This reflection enlightens and provides more understanding of how to apply these approaches. The research questions in this study required both approaches to describe and investigate the research aims effectively and to facilitate the full understanding of the data from the two perspectives. Mixed methods make research findings more interesting and help the researcher to understand the research properly, which could be seen from different perspectives [211].

In this study the mixed methods approach was applied in the form of an exploratory case study, which prioritised the qualitative and quantitative methods [26, 153] as described in subsections 3.4.1 and 3.4.2.

3.4.1 Qualitative methods

A qualitative approach enables the researcher to explore concepts in-depth with the chosen sample of research participants and to observe the concepts being described in the research [138]. The goal of this qualitative research from multiple perspectives involves an understanding of social or human problems [242]. This method is basically seen in the form of stories and accounts that assist the researcher in understanding the feelings, opinions, and beliefs of each participant. Qualitative methods of data collection use an interpretivist epistemological approach. The data are the exact expressions and thoughts in the words of the research participants [202]. Qualitative data are semi-structured or unstructured data, which may be analysed using, for example, in our own case, the popular thematic analysis and content analysis with open-source coding, although, in this case, the research questions usually include subsidiary questions. As explained initially, the research questions regarding the qualitative data are answered by describing or explaining the events that could lead to collating the participants' understanding, beliefs, and experiences. The researcher in this case does not have full control of what they are hoping to obtain until the end [203]. The research usually evolves during the process, as the main tool of the research is the researcher, because the various coordination of the data collection processes is controlled by the researcher.

3.4.2 Quantitative methods

Quantitative methods were applied to analyse our numerical data and the interpretation of our questionnaires. Quantitative research methods are concerned primarily with gathering and working with structured data, which can be presented numerically. This method typically uses a positivist epistemological approach. The data collected using this approach can be statistically analysed. Quantitative data are structured and analysed using statistical analysis in most cases, including in this research. In this case, the researcher already knows what they are looking for and hoping to obtain, as the research questions are set as a testable hypothesis [203]. The research questions involved in this approach can be answered by counting the individual events and applying statistical analyses to evaluate the results. The expected result in some quantitative methods in most cases is known or could be predicted.

The research design is usually solidly developed before the data are collected. In this case, unlike the qualitative methods, the researcher is never part of the research evolution, as the research involves the use of research tools or instruments designed to collect the data. In our case studies, we used an existing framework OSLQ instrument that was modified as the research framework tool for data collection. One benefit of this quantitative data method is that it is possible to generalise the data because they are represented either numerically or are coded, which could easily reveal the themes from the analysed results [202].

3.4.3 Significance of the mixed approach

There are several approaches applied in the combination of different methods [129]. This mixed approach uses qualitative data analysis to describe the data [248, 176]. The importance of this mixed approach is that it explores an understandable series of steps to help the researcher manage a large volume of data, and complex qualitative data were made easier to understand [176]. This mixed approach could be applied for both the individual interview data and focus group data. In contrast to quantitative data analysis, qualitative data analysis is undertaken concurrently with the data collection processes. This qualitative data analysis for the focus group applied a coding technique with this mixed approach [176].

3.5 Sampling

The question on sampling arises from defining the population sample on which the research is focused [68, 67]. The population is the total number of cases that could be included as a subject in research. For instance, this could be the total number of students studying a course in an institution [202, 203]. The underlying participant population was drawn from around the world. A sample in this research refers to a selection of participants from the total population. This study represents this as an actual sample in Tables 3.1 and 3.2. This approach to representing the population sample from the selected original population is mostly applied when designing experimental and survey research, where the data are gathered using quantitative and qualitative methods. This method of selecting the sample enables statistical analysis of the data [203].

The sample size: The study had 109 registered participants of which the clear majority of 82 participants were in the online version or mode of the eLDa platform. These participants were undergraduate and postgraduate students, teachers of computer science, and learning technologists. For the blended-learning course, a sample of 22 students was drawn from first year undergraduate students in the computer science department at the University of Warwick. The student population was sampled from those who registered for an optional module of computer security.

Consent form before participation: A consent form was given to all participants, as shown in Appendix A. For the online course, a copy was placed online, which the learners could read and agree to before participating. The online learners were also informed that the collected data would be used solely for research purposes. For the blended-classroom students, a physical copy was handed to each student to read and sign. Any area of the consent form that the students could not understand was explained. The consent form had the address of the registrar's office for any student who could be uncomfortable with any of the aspects stated on the form to contact, as contained in the research ethics section 3.8 and Appendix H. Fortunately, this did not occur.

Figure 3.6 demonstrates the sampling approaches considered in this study. The research focused on two main types of non-probability sampling.

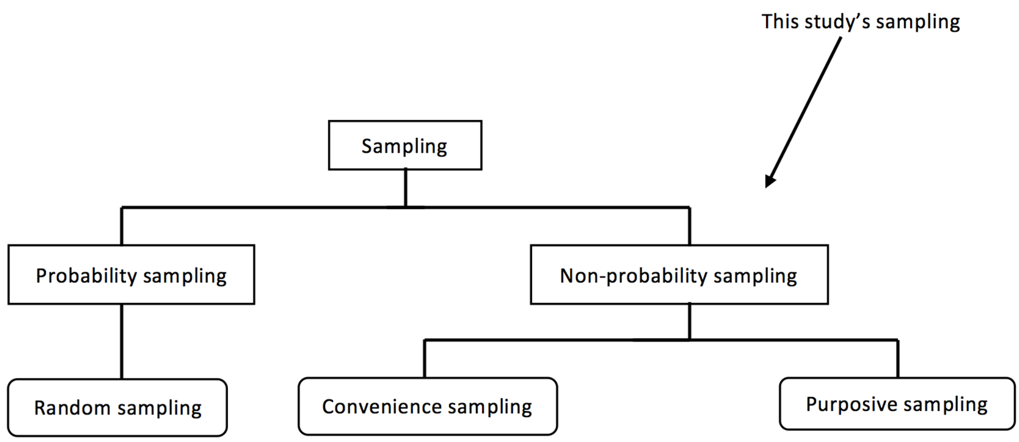

Figure 3.6: Sampling used in this study.

3.5.1 Non-probability sampling

Non-probability sampling is defined as a sampling approach that does not rely on the rationale of probability theory. Non-probability sampling does not involve random selection, as probability sampling does [306, 308]. It is not necessarily accurate that non-probability sampling does not represent the sample population. A study shows that the probability sampling does represent the population sample effectively; in this case, the confidence interval is shown within each statistical case [307]. However, with the non-probability sample, the population may not have been presented accurately, and most of the study shows how much interest has been devoted to probabilistic and random sampling methods over the non-probabilistic approaches. Additionally, the probability methods are considered rigorous in analysis [308].

However, this study applies some aspects of social science research techniques: mixed methods of qualitative and quantitative approaches. Thus, probability sampling will not be suitable in this case. Probability sampling will not be feasible in investigating practically in terms of focus group discussion, theoretical interpretation of the data, and description coded themes, surveys, semi-structured interviews, and so on, as conducted in this study. It would not be sensible to conduct a random sampling or probabilistic analysis with any of these data to yield any meaningful evidence and results. This study applied a wide range of non-probabilistic alternatives, which could be divided into two main types as described in subsections 3.5.2 and 3.5.3, which are applied in selecting this study sampling.

3.5.2 Convenience sampling

A convenience sample is a type of non-probability sampling method that comprises a population of people who could easily be reached [104]. Convenience sampling (also known as availability sampling) is a specific method that relies on data collection from members of a population who are conveniently available to participate in a study [264]. One of the most common examples of convenience sampling is using student volunteers as subjects for research [93, 263]. Normally, this sample uses the first available data source for the research without searching for additional requirements [93]. Convenience sampling is used in most pilot studies because it allows basic data and trends to be obtained with respect to the study without any complications. The pilot study conducted in this research applied convenience sampling to select the initial subjects (students) to participate because of their proximity to the study location and availability in accessing the online test experiment [120]. Convenience sampling is the most commonly used of all the sampling techniques because it allows easy recruitment of subjects that are selected from a large population [104, 224]. The purpose of using convenience sampling in research is that it is inexpensive, fast, very easy, and the subjects are readily accessible and available [103, 91].

First-year students were selected based on convenience sampling [68]. They were taking part in a group seminar organised for the module and delivered using an online blended-classroom technique. To select this sample of students, an email was sent to all students informing them of the planned survey before the seminar class.

Table 3.1 shows the first survey conducted in the early classes of the seminar with five more students from the other seminar group joining our session for the week (n = *27*) and the second survey on the SRL questions, which was conducted at the end of the seminar (n = *22*). In both surveys, only those students that were present could complete the survey form and hand in their copies, together with any consent form from those who had not submitted one. The actual sample is the same as the initial population sample. There were variations in the survey questions and the respondents of both questionnaires (as seen in Table 3.1).

Table 3.1: Blended-learning survey samples.

Surveys	**Population**	**Actual sample**	**Questions**	**Respondents**
Blended survey	27	27	37	27
Post SRL survey	22	22	27	17

3.5.3 Purposive sampling

A purposive sample is also a non-probability sample that is selected based on the common characteristics of a sample population, and it could be selected based on the study objective. Purposive sampling is also known as selective, judgemental, or subjective sampling [264]. One of the main characteristics of purposive sampling is to focus on a specific group of interest to enable effective investigation of the research questions [177]. Purposive sampling is a non-random approach; it does not require any underlying theories or a large set of participants [103]. In this case, the researcher decides all that is needed for efficient understanding. The study explores a sample population that is willing to participate and provide the information being investigated, either based on experience from the study or external experience [37]. This technique is typically applied in qualitative research to identify the information being investigated [243]. This approach involves the identification of individuals or organisations that are capable and knowledgeable in the phenomenon of interest within the study [77, 78]. The study further narrows the sampling to a phase of purposive sampling known as homogeneous sampling.

Homogeneous sampling: In homogeneous sampling, the participants are selected based on similar characteristics. For example, people with similar occupation, backgrounds, and so on [177]. This instructional online course was designed for teachers of computer science in the UK. As an online course, it was accessible to anyone, and was opened to students that participated in the pilot study. In this case, it is a mix of convenience and purposive sampling. The online course used purposive sampling, in the sense that there was an organisation or unit for which the study was targeted. The course was initially developed with the notion of involving participants who were experienced or less experienced in teaching computing concepts and Python programming.

In Table 3.2, the total registered learners were 107 which was the population sample, for which we had 48 active learners (actual sample) who had either participated in the course, or lurked to know more about the course (called lurkers). The various surveys had different questions and different respondent levels, as seen in Table 3.2.

Table 3.2: Online course survey samples.

Surveys	**Population**	**Actual sample**	**Questions**	**Respondents**
Course entry	107	48	15	27
MOSLQ	107	48	19	11

In summary, the focus group semi-structured interview discussion applied convenience sampling in selecting some students from the blended-learning seminar who were available to participate in the focus group interview sessions. The sample of the online course survey was based on a mixture of selected students continuing the course after the pilot study, those who were engaging in a blended-learning approach, and other professionals (teachers of computer science selected using purposive sampling). Therefore, both sampling methods were deemed to be appropriate, as the learners decided on their own to fill in the survey after they read the consent forms with respect to both case studies, and the reason for the survey, namely, that it was for research purposes.

3.6 Data Collection Methods

Mixed methodology was used as the technique for this research. The research argument was approached from a case study perspective, which was used for the collection of the quantitative data. The research employed two different forms of questionnaires: (i) online questionnaires and (ii) blended-classroom questionnaires. The online questionnaires were applied to the regular online course, while the traditional classroom setting questionnaires were applied to the blended-learning seminar course. In addition, as part of the mixed approach, we employed the use of a semi-structured focus group interview to form the research argument and form part of the data collection process (as seen in Table 3.3). Following this, the researcher evaluated the findings from the study, giving substance to the literature reviews to correlate with the argument of this research contribution. A further investigation or evaluation of the study platform was presented using a qualitative approach, with data being collected through a general survey questionnaire conducted in both modes of study (online course and blended-classroom seminar). In addition, the SRL questionnaire was used to gather the perceptions of the participants. The semi-structured focus group interview comprised an hour of discussion with mixed questions of general demographics and SRL.

Table 3.3: Data collection process.

What was done	**Details**
Stand-alone course.	MOSLQ and in-course surveys conducted to gather data with regards to learners perceptions of the online course, and to investigate SRL skills with a sample size (respondents) of (n = *11* and n =*27*, respectively) (as seen in Appendices C and D).
Entry survey : Online blended course seminar.	Seminar survey conducted second week of the online blended course with a sample size (respondents) of (n=*27*), (see Appendix E).
Post seminar survey: SRL.	This seminar survey was conducted at the end of the seminar. The focus was to collect data about SRL skills with a sample size (respondents) of (n=*17*), (see Appendix F).
Focus group interview with group 1.	Semi structured focus group interview with a sample size (respondents) of (n = *6*), (see Appendix G).
Focus group interview with group 2.	Semi structured focus group interview with a sample size (respondents) of (n = *3*), (see Appendix G).

The detailed approaches used to collect the data were as follows:

(i) Pre- and post-surveys administered to all participants, gathering both general information (about the user, their aspirations, their experiences of the course, and so on) and an existing standard instrument to assess aspects of SRL;

(ii) Mini in-course surveys relating to each section of the course resources;

(iii) Log information from the system that can be examined (using Google Analytics) to determine user routes and usage patterns of the course resources;

(iv) Quiz results demonstrating learners' knowledge and understanding of the areas they study;

(v) Semi-structured post-course interviews conducted to gain better insight into learners' individual progress, perceptions, SRL and acceptance of the course concepts.

3.6.1 Questionnaire

One of the most common ways of gathering social data in research is using questionnaires. A questionnaire is a list of questions each with a range of answers that are relatively structured in a standardised format that would enable data gathering and analysis. Questionnaires are used as a tool for market research to gather people's opinions and wishes [202, 203]. Following the later part of the 20$^{\text{th}}$ century, questionnaires came to be used by the government to conduct large-scale surveys. Nowadays, in the 21$^{\text{st}}$ century, questionnaires are applied in almost all aspects of social research, from small-scale to large-scale international surveys [218]. A feature they all have in common is the formulation of the set of questions and answers that are tailored to the researcher's needs, hypotheses, or research questions [202].

In a more precise definition, a questionnaire is a collection of questions that are answered by research participants in a manner that should answer the research questions. They must be developed to collect structured data, which includes sets of answers needed from which the respondents can choose. However, some questionnaires may include open-end questions and closed-end questions that give the participants the choice to answer the questions as they wish [89] (as shown in Appendices C, D, E and F).

The study used questionnaires as an instrument to collect data on the learners' SRL skills. The questionnaires in this study were two-fold: first, an adapted online SRL questionnaire and second blended-classroom hard-copy questionnaires. The former was conducted in the online platform course, while the latter was conducted in a blended-classroom with the respondents completing the form and returning it in class. The main reason for using questionnaires was that the research aimed to understand the learners' SRL skills both in the online platform and in the blended-classroom setting.

The questions in the questionnaires were designed to suit the research questions, incorporating the six dimensions (or strategies) framework in this study [28, 29]. The questionnaires were constructed with both open-ended and closed-ended questions, which were the same for all participants in the cohort. The questionnaires in this research were applied to two different cohort contexts or case studies (the stand-alone online course and blended-learning course). The participants in the cohort only answered the questions of the cohort. However, the wording and structure for the online questionnaires were different from those of the blended-classroom. For ethical reasons, all the questionnaires in this research are anonymous, and participants were informed about the anonymity of the process. Care was taken in designing the questions in such a way that they would not be perceived as judgemental or insensitive to participants, to allow them to answer the questions without any embarrassment or shame. The data from the open-ended questions were categorised and coded to allow the use of statistical techniques to analyse them.

3.6.2 Semi-structure interview

Interviews form one of the most common data collection approaches in research. The application of face-to-face interviews as a prominent method of gathering data is common in both qualitative and quantitative research [202]. Interviews create a direct contact between the researcher and participants [135]. This study conducted semi-structured focus group interviews, which were conducted over two days. This semi-structured interview focus group allowed effective communication of knowledge and experiences in a face-to-face manner. Semi-structured interviews were applied in various ways in collecting the data. They were mostly related to collecting qualitative data, where participants' interests, experiences, behaviours, and understanding were explored. In some cases, the researcher was mostly concerned about the information each participant provided concerning a specific topic or topics during the interview.

The study applied a semi-structured interview approach to conduct the focus group discussion in an exploratory manner. This approach was used to explore participants' thoughts regarding the research perspective during the focus group interview. The first focus group interview helped the study to re-organise and formulate more structured methods of gathering the data using the same questions on the second day of the focus group interview. In addition to exploration, semi-structured interviews can be used in an explanatory way to help gather data that will help the researcher to understand participants' experiences, opinions, and feelings. This approach brings a better understanding to 'why' students study, using distinct approaches in this research.

Semi-structured interviews allow the participants to explain and share their experiences, perceptions, and values in accordance with their own patterns of learning. The reason the semi-structured interview approach was applied in this study's focus group discussion, was because the data collection process was appropriate to our convenience sampling, which was made up of selected students with experience in the research topics, enabling the study to explore the research questions in a more logical manner to develop a research theory. During the semi-structured interview, the researcher made sure all participants had enough time to contribute to the discussion. These focus group interviews were well coordinated, with no distractions.

3.6.3 Focus group interviews

A focus group is a qualitative data collection method that adopts an interview technique [211]. It is said to be a group interview in which questions are sometimes semi-structured. It is used in research to generate data from a discussion between the focus group participants coordinated by the facilitator [202, 203]. Focus groups have been used by researchers for a long time. Robert Merton, a sociologist, coined the term focus group as 'focused interview' to describe an interview with a group of 12 [214, 212, 213]. However, the techniques used by Merton were argued to form the basis for individual interviews. Focus groups were popular as a marketing tool in the early 1960s [41]. In the early 1980s, focus groups were widely used in the public sector to ascertain political opinions in the social sciences [217]. The focus group interview in this study was conducted using a convenience sampling approach to select participants from the blended-learning seminar. Semi-structured interview questions were applied for the focus group discussions. The analysed results provided insight into how the course is perceived and how it could be further improved. The questions used for these focus group interviews were similar to the structure and approach applied in this study's MOSLQ by using the six SRL dimensions (as seen in Appendix G). Table 3.4 lists the number of participants involved, the duration of the focus group interviews and transcription.

Table 3.4: Duration of the focus group activities.

Groups	**No. of Participants**	**Total duration**	**Transcription duration**
Group 1	6	1 hour 11 minutes	31 hours
Group 2	3	1 hour 5 minutes	32 hours

3.7 Data Analysis

This study also employed an empirical approach, which involved how to evaluate the gathered information based on experience, observation, and experiment. In the quantitative approach portion of the mixed methodology, we applied content analysis to analyse the data. A descriptive statistics concept is applied to evaluate the

MOSLQ (both online course SRL and blended-classroom SRL). The semi-structured focus group interviews were evaluated using thematic analysis. Standard statistical methods have been shown to be accurate in data analysis and remain a vital tool in determining the legitimacy of any empirical research approach.

3.7.1 Content analysis

Content analysis is the process of summarising and reporting the important written content of any data. Some authors [109, 205, 172, 173, 323] define content analysis as a systematic procedure for rigorous analysis, investigation, and 'verification of the contents of a written data'. They infer that it is 'a research technique for making replicable and valid inferences from texts' to the context of their usage. Content analysis is often applied in analysing large quantities of text [100]. It is 'facilitated by the systematic, rule-governed nature of content analysis' [67]. It is an 'unobtrusive technique' [172], and 'one can observe without being observed' [251]. Content analysis focuses on the meaning in the context of the data and on a systematic order of the use of codes and categories [205]. However, as the data are in text format, verification through re-analysis is needed, and there is also the possibility of replication. Content analysis is largely used as a device for extracting numerical data from word-based data [68]. Indeed, some studies have argued that it describes 'relative frequency' and the significance of certain topics to evaluate bias and prejudice in the content materials [9, 12].

The content analysis approach was applied to the focus group qualitative data. First, themes were created that are related to the six SRL dimensions. The research used a colour-coding process to initially identify text with different themes and patterns. This enabled the grouping of different ideas to gather evidence of opinions that have emerged from each of the themes. This process enabled us to determine the number of occurrences of the various themes or phrases in the transcribed text [198].

3.7.2 Thematic analysis

Thematic analysis is known as the process of segmenting, categorising, and relinking some aspects of raw data prior to conducting the interpretations of the data [128]. The qualitative data were interpreted in a comprehensive manner to obtain a good knowledge of understanding of the conversations, stories, words used in responses, and opinions of the participants. This process of thematic analysis helped in identifying relationship patterns with the data themes. This also explains the similarities and differences found within the raw data. Throughout the thematic analysis process, reflexive and reflective understanding of the data interpretation and themes should be crossed checked with the raw data.

The analysis of qualitative data involves constant interpretation of the raw data gathered by the researcher. The process of data analysis usually begins as soon as the data are collected. In some studies, the collection and process occur concurrently. However, in this study, the researcher had to complete the analysis of the first case study, which has a different dimension theory, before continuing the analysis of the focus group study. In qualitative analysis, themes and theories emerge from the raw data as it is being processed [202]. For the research to demonstrate credibility and transparency of the qualitative data analysis, the analytical approach should be as follows.

- Systematic and comprehensive enough to reflect the same procedures applied in all raw data and cases.
- The data should be grounded (in its natural stage), that is, it should be returned to the raw state throughout the analysis process.
- The process should be dynamic because the themes and theories in most cases emerge during the interpretation of the processed raw data. In this case, the researcher should be open-minded during the analysis, and the full research analysis cannot be planned prior to the start of the actual analysis process.
- The openness of the research interpretations should make the framework accessible by other researchers.

3.7.3 Statistical analysis

Statistical analysis of data is the part of data analytics that summarises and describes the data collected in the research study. In this case, all the data in a set of items are scrutinised to draw conclusions [202, 203]. The use of statistical analysis on the data collected from this research is to help describe the features observed in the data, which has helped us identify areas that are relevant to the thesis research questions. This process also helped in testing the relationship between the different types of datasets collected from the two cohorts (case studies). This statistical data analysis is applied to the structured data, as in quantitative data, and can be counted or expressed numerically. This type of data is usually collected using a questionnaire.

Statistical analysis was applied in this study to calculate the average of a set of data and the number of related participants in our sample data. Most of the structured data analysed in this study are based on counting the numbers of responses to each question, and the result of the findings are presented either in tabular form (table), charts, or diagrams. However, since our samplings are known, statistical analysis is most appropriate for the data analysis. This helped generalise our findings to the selected sample [202]. This research expanded from a small-scale to large-scale project with the combination of the two case studies (online stand-alone course and blended-learning course). These cohorts led to the decision of a mixed methods research with both structured and semi-structured data, and the techniques for this analysis are appropriate in all cases.

Average actual sampling: The sampling in this study is measured based on the specific response unit of a learner. The average of the selected sample within the six SRL dimensions in this study was calculated. The reason we performed this initial average was to obtain the estimate (average estimate) of the sample from the different dimensions in our study.

Average of the population sample: To measure the parameter of the population, we calculated the average of the entire sample.

3.7.4 Deductive and inductive coding

This section describes the use of both deductive and inductive analysis to interpret the data from the focus group interviews on the role of SRL in improving academic attainment in a blended-classroom context. The deductive themes were the six SRL dimensions and some predicted themes expected from the discussion in this study were part of the inductive coding themes. The methodological approach considered integrated initial data-driven codes, which forms the initial-order theme from which the focused-order themes were derived. The theory-driven codes emerge from the clustered theme, and this forms the final-order theme for the analysis. The study presents a detailed description of the various stages of the data coding processes that leads to the identification of the initial and focused themes. This process demonstrates the analysis of the focus groups' interview data from the two transcripts that were analysed. These transcripts helped identify overarching themes that captured the distinctive self-regulatory learning skills exhibited by the students as described in the study.

3.8 Research Ethics

Research that involves learners' participation and personal data collection either in the form of demographics or other survey questions must abide by ethical guidance and good conduct of practice [81, 295]. Before this research proceeded, and in advance of the data collection activities, appropriate ethical approval was sought and obtained from the University of Warwick Biomedical and Scientific Research Ethics Committee (as shown in Appendix H). On approval, the university reference number allocated to this research was: **(Reference: REGO-2015-1635 Onah)**.

3.8.1 Respect for participants' rights and dignity

This research was conducted with ethical concepts in mind [241]. All data collected was treated with absolute confidentiality throughout the research process. No participant was put in a compulsory situation to respond to any survey question or interview. All participants in the course were given the option to willingly participate in the process of the data collection. Detailed information was given in advance concerning the nature of the survey questions and the focus group interview, and how the data would be used solely for the purpose of the research to improve the design of the eLDa online learning platform. The participants were not placed in a position of responding to any question they were not comfortable with. The focus group interview and the online survey questions did not identify any race, religion or beliefs. All participants were informed that they had the right not to participate and that if they chose not to, they would not be treated any different within the course.

3.8.2 Privacy and confidentiality

The researcher ensured that there was absolute confidentiality during the analysis of all the data that was collected. The researcher ensured anonymity in all reports, papers and journals that were published [36]. We guaranteed the confidentiality of all the participants, and no individual was identified in the course of this research, except where approval was given. The information of participants and organisations involved in the research study was not exposed in any form to the public. The researcher assured the participants that no data obtained from the research would be shared with any third party, and that it would be used solely for the research purposes. We ensured that there were no interview or survey questions that lead to any sensitive issues with any participant during this research. In accordance with standard university practice, the data records from this research will be stored securely for a period of ten years within the university, after which they will be destroyed.

3.9 Summary

This study encompassed several dimensions from two case studies. To this end, DSRM was the overarching research method in this study. The methodology was used to investigate the ability of the learners to self-regulate their study habits and observe whether the learning platform could motivate and help participants to increase their SRL skills through learning modes. Self-regulation in an online context is the process of both the course improvement and the learner developing skills to achieve their aims [28, 29]. In brief, the overarching research methodology was used in this study to address the issue of the lack of good pedagogical practice in online education. While e-learning technology has been in use in online education for a long time, little has been addressed about the course development structure and the initial preparation by learners before participating in an online course. This issue has led to the motivation to develop a novel tool to investigate the SRL skills of the participants. The eLDa tool is an e-learning platform with two modes. One allows the learners to study at their own individual learning pace, and the other is a guided instructional learning approach that encompasses lesson prerequisites. These lesson prerequisites are suggested to the learners as content recommendation to enable them to study, according to guided instructional routes.

The study has incorporated novel features to contribute to learners making their own informed choices and to prepare ahead of a lesson in a self-pace mode with adequate preparation to engage with the course content. Different methodologies applied to address the main research questions in this study were presented. A mixed methods research was appropriate for the study because of the distinctive range of data involved in the research [211]. The data collection processes were extracted from quantitative and qualitative methods of data collection for which structured and unstructured data were investigated. The data were then analysed for proper understanding and interpretation. The anticipated discussion on ethical issues was addressed in this study. The research purposes were made known to the participants, and consent was received.

Chapter 4

Design and Implementation

This chapter will briefly summarise and reiterate the initial idea of MOOC platform designs to show the constructional differences between existing systems and the research tool. This chapter addresses the first and sixth research questions:

1. To what extent is self-regulation needed, promoted, and supported in current mainstream MOOCs?

6. What are the implications for MOOC pedagogy to foster SRL?

4.1 Introduction

Many MOOCs do not appear to be good at engaging learners or at providing the necessary 'high impact' learning activities related to deep learning. A recent study points to the largely passive nature of learning in most MOOCs [1]. This research introduces a novel MOOC learning platform known as 'eLDa', which implements a new approach to MOOC structure and incorporates several theory-based features specifically aimed at addressing problems associated with high attrition. In particular, the framework supports users in establishing their own learning objectives and individual learning paths. This research seeks to investigate the relationships between learner choice, learner engagement, and development of capacity for SRL. Our approach allows 'success' to be defined not in terms of full completion of a course, but whether learners achieve their objectives. The eLDa platform has been trialled with an adapted version of a course previously run in traditional MOOC style. Data have been gathered from learners in each of two modes: (1) learners set their own goals, self-direct and study in a self-regulated manner and at their own pace and (2) learners follow an instructor-led, structured path of study.

Section 4.2 presents a general description of e-learning course development. Section 4.3 presents a discussion on the active learning habits of students. Section 4.4 extensively describes the tool for this study, and the development and features that were incorporated to meet the research objectives, and the course architectures for the two case studies. Section 4.5 illustrates some security issues identified during and after the course design. Section 4.6 presents the significance of the course platform design. Section 4.7 describes challenges encountered within the research tool. Finally, the last section summarises the design goal, the components, and implementation of the eLDa platform tool.

4.2 E-Learning Course Development

There are many e-learning course platforms in existence, but little is known or has been discussed about the development of MOOC platforms and the components and features. In addition, MOOC platforms generally incorporate a one-size-fit-all mode of learning. According to Alexander [3], the purpose of most e-learning platforms is to focus primarily on developing courses and learning resources that will be appropriate for linear course structure as directed by the instructor. Some course instructors have constantly revised their content to improve the learning structure, deliver better interactive courses, and ensure learners attain full satisfaction from the platform [99].

However, the success of any e-learning course platform should consider the following objectives: the learners' entire learning experience, the strategies used in developing the course content, the planning of the course delivery, and the methods of delivery. Therefore, all e-learning platforms should primary focus on the way students learn to enhance their own learning skills and help regulate their learning habits [186]. Another related study on the successful implementation of e-learning platforms [124] proposed that the success of any e-learning course implementation should be carefully considered in regards to the course's underlying pedagogy and how the learner engages with the online content. However, this is one of the most important factors that have been lacking in most MOOC learning platforms and their evaluation.

4.3 Active Learning

Active learning refers to approaches in which students actively participate by 'doing' rather than passively listening. It has long been associated with improving attainment, particularly in STEM subjects [111]. The passive nature of most MOOCs means that students' options for effective engagement are limited, that there may be a lack of interest and that dropping out is more likely [1]. Further, the rigid structure of most MOOCs takes away all the control from the learning, leaving a content-centred, linear course in which the instructors set goals. The ability for learners to take charge of their own learning (for example, by setting goals, developing learning strategies, and self-reflecting) is one aspect of SRL, and effective self-regulation is associated with improved learning and greater retention [348].

Effective e-learning can promote learner autonomy by enabling students to set out goals and plan a route to achieve them [80]. Autonomy is characterised in e-learning as the freedom of movement by the learner within the learning environment, without any concern for a predetermined order or sequence [208]. Lack of self-regulation skills may prevent online learners from accomplishing expected learning tasks [29]. Currently, most MOOCs allow little autonomy, encourage passive learning, and do not promote SRL. One of the main aims of our novel tool is to allow learners to have the autonomy to direct their learning and choose a route suitable for their learning styles. Section 4.4 discusses the eLDa research tool, the design goals, the implementation processes, and the novel features that contributed to this research investigation.

4.4 The eLDa Platform

4.4.1 eLDa: The Research Tool

This section introduces a new learning platform known as eLDa, designed as an intervention to mitigate the prevalent dropout issues in a MOOC. The eLDa platform is developed to allow learners to participate in the course in a self-directed mode and be guided to the end of the course. This study introduces a new MOOC approach that aims to involve participants in their own learning more actively, providing the necessary framework and support for participants to set their own learning objectives and to access resources appropriate for their needs. To support these learners, a prototype-learning platform was developed to investigate the approach [320]. It has been developed to incorporate and analyse the effects of novel features, such as SDL and instructure-led learning to encourage learning motivation, provide support, and help foster self-regulation. The platform was implemented in WordPress with some plugins to support new features, allowing users to navigate as they desire to pursue their own learning objectives or follow an instructional path provided by the course developers to achieve overall course goals. Moreover, eLDa incorporates a variety of acknowledged MOOC ‘good practice’ features to support learners and mitigate learner dropout. It was trialled using resources adapted from a previous MOOC providing in-service tuition training for teachers new to computing and covered computing concepts, programming, and classroom pedagogy. To be able to improve the platform for live sessions, we conducted an initial pilot study with a selected sample of research students and undergraduates in the Department of Computer Science and the School of Education Studies at the University of Warwick. The pilot study results helped to implement a laudable platform appropriate to learners’ needs as a result of the surveys and feedback received from the participants.

Why WordPress? WordPress is a free and open-source content management system (CMS) based on Hypertext Preprocessor (PHP) and My structure Query Language (MySQL). The choice of WordPress as our virtual learning environment or LMS in this study arose because of its CMS compatibility to our research design and objectives. WordPress creates a visual representation of the course content such as modules, sessions, and lessons. This visualisation enables the learners to decide which mode out of the two modes of study to follow. The main research design objective was to create a course that would allow learners to make a choice of the route to follow, either a self-directed route or an instructor-led guided route. WordPress is compatible with the design of the MOSLQ instrument used to explore and investigate learners’ SRL strategies.

4.4.2 Prototyping and iterative development

This course did undergo revision from the initial test bed prototype. The feedback received from the pilot study informed a better way of redeveloping the platform to support learners in their chosen mode. Research has shown that the waterfall model offers a framework for addressing crisis in system development and design specifications. Prototyping is a complement to a full system development, where one or more operational models are designed to understand or show an idea [255]. A prototype system develops a semi-completed idea, which displays an abstract viable for testing purposes [320]. In order to investigate the appropriate platform for this eLDa system, we trialled the platform development from Moodle LMSs to WordPress and Easygenerator to the final version that was developed successfully in WordPress. The prototype system was tested for usefulness and feasibility after evaluating the other phases before trying it online as a live version.

4.4.3 The eLDa waterfall model

Figure 4.1 specifies the eLDa waterfall model for the system specification and requirements. An analysis of the system requirements was conducted, and components to support the course's novel features were investigated. After this stage, the system design and development process began. The system encountered some difficulties at the initial stages and failed thrice. Finally, a suitable CMS open-source platform (WordPress) was used with some supporting plugins to design and implement the prototype system. The initial test pilot study was conducted before deploying it live after some modifications based on selected participants' feedback. The system was further maintained, and the evaluation of the feasibility of the platform and the extracted data were analysed.

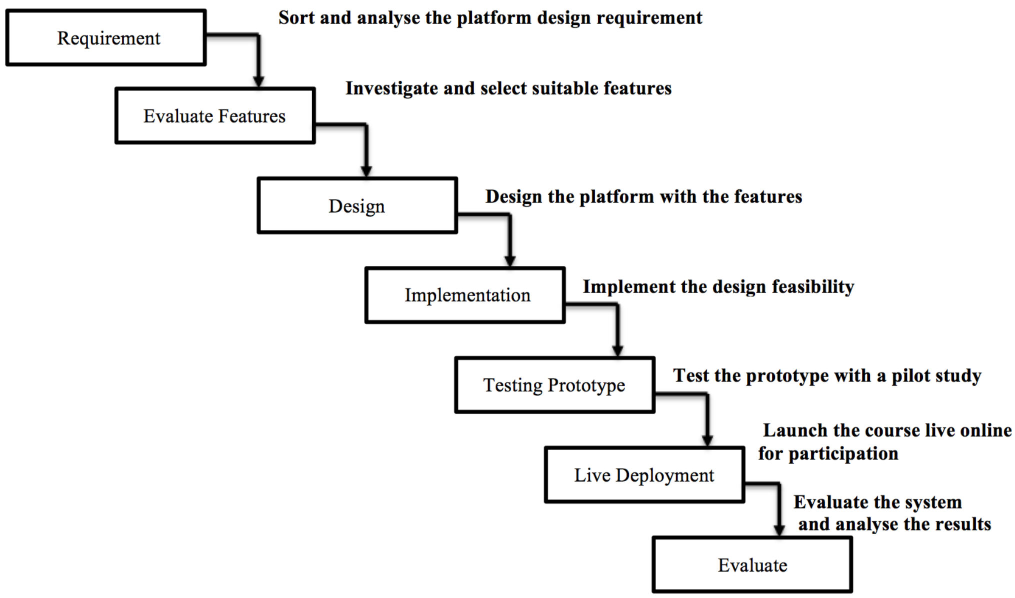

Figure 4.1: The eLDa platform specification and flow model.

4.4.4 The eLDa course process

The eLDa platform supports a novel approach to MOOC development, which aims to actively involve participants in directing and regulating their own learning. It provides the necessary framework and support for participants to set their own learning goals and to access resources suitable for their needs. Each course (or module) was divided into 'sessions', which correspond to a coherent topic of study that in a traditional, directed MOOC mode might form a week's unit of work. Each session was made up of several 'lessons' with related concepts and content. In a directed mode of study, lessons are generally offered sequentially and mastery of all previous lessons or sessions is assumed in the current one. The eLDa platform decouples resources at the lesson level. Prerequisites are introduced to inform learners of necessary previous knowledge and, where appropriate, in which parts of the current MOOC that can be found. Learners can decide whether they wish to tackle that lesson with their current knowledge of prerequisites or whether they would prefer to review the suggested earlier lesson(s) first. A roadmap allows the user to see whether they have already studied the prerequisites. A learner can decide at any point to switch between modes. This can be useful, for example, if a learner wishes to refresh their knowledge of parts of earlier material, but then follow the course in a directed way.

The course implemented on the eLDa platform to trial the approach was a computing MOOC, originally developed to provide continuing professional development for UK teachers. This course had previously been run twice in a traditional MOOC format, with over 900 participants. It was therefore possible to use tried and trusted materials from the existing course, adapting them to the needs and format of the current context and creating additional materials as needed. The course covered computing concepts, introductory programming using Python, and computing pedagogy. It comprised seven sessions and a total of 41 lessons including the prerequisite lessons, as shown in Figure 4.2.

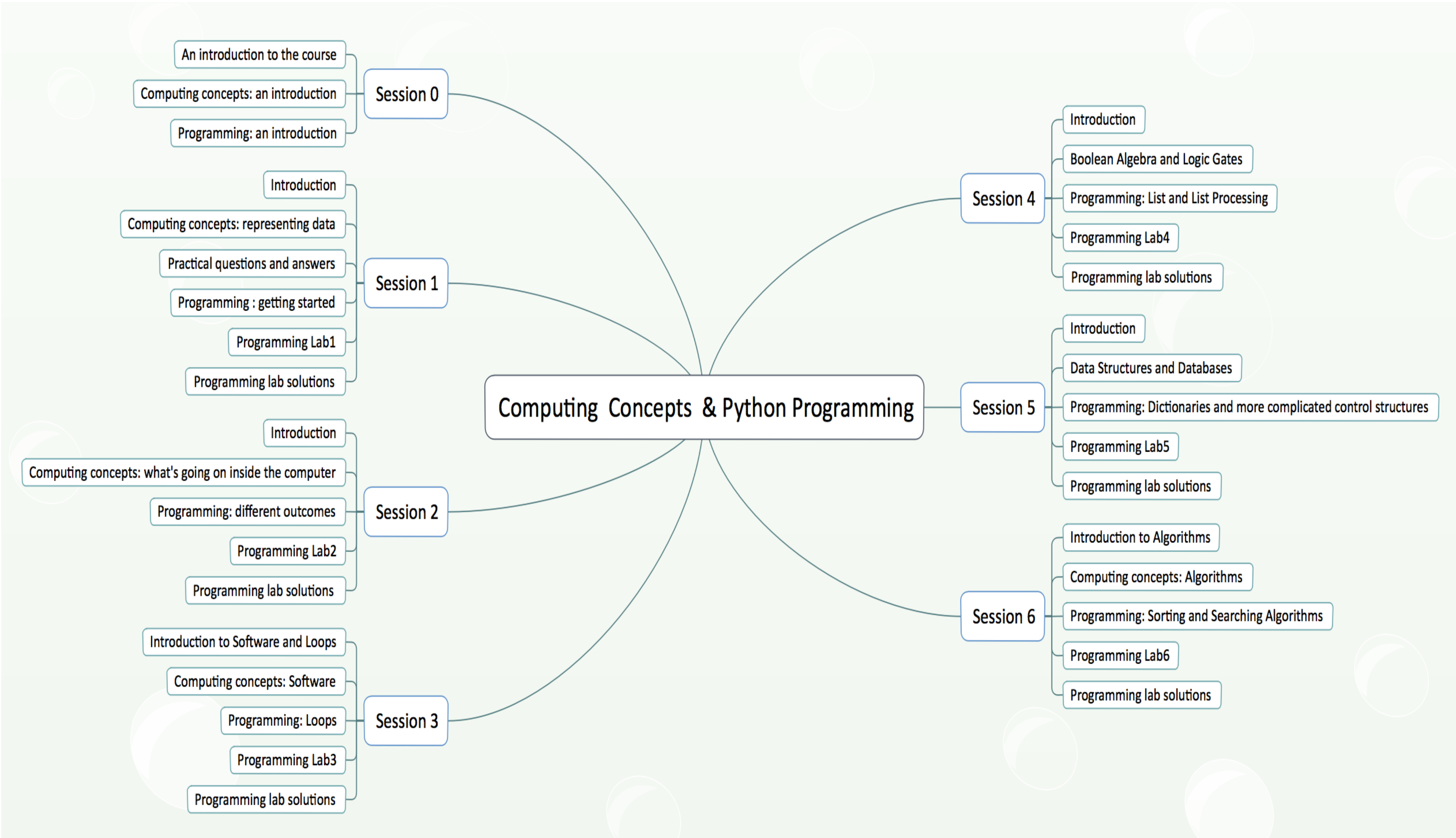

Figure 4.2: Computing Concepts and Python Programming (online course).

Many of the features of traditional MOOCs were maintained, such as lecture videos, quizzes, and forums. As noted above, care was taken to include other aspects of accepted good practice, such as incentives in the form of badges and social communication tools. Additionally, decisions were made on several aspects that could enhance the learner experience. For example, one such feature was the introduction of a facility for learner-tutor and peer-to-peer interaction. Although not the focus of the current analysis, this was thought to be a useful means by which to encourage social interaction and provide additional support. It was important to explore different opportunities for social learning, given that participants on a self-directed path are not following a set timetable; therefore, it is more difficult to coordinate interactions on, for example, a general forum. The blended-learning ran for five weeks in seminar format and an extra week of lessons was provided to expose the students to effective and active learning practice, as illustrated in Figure 4.3.

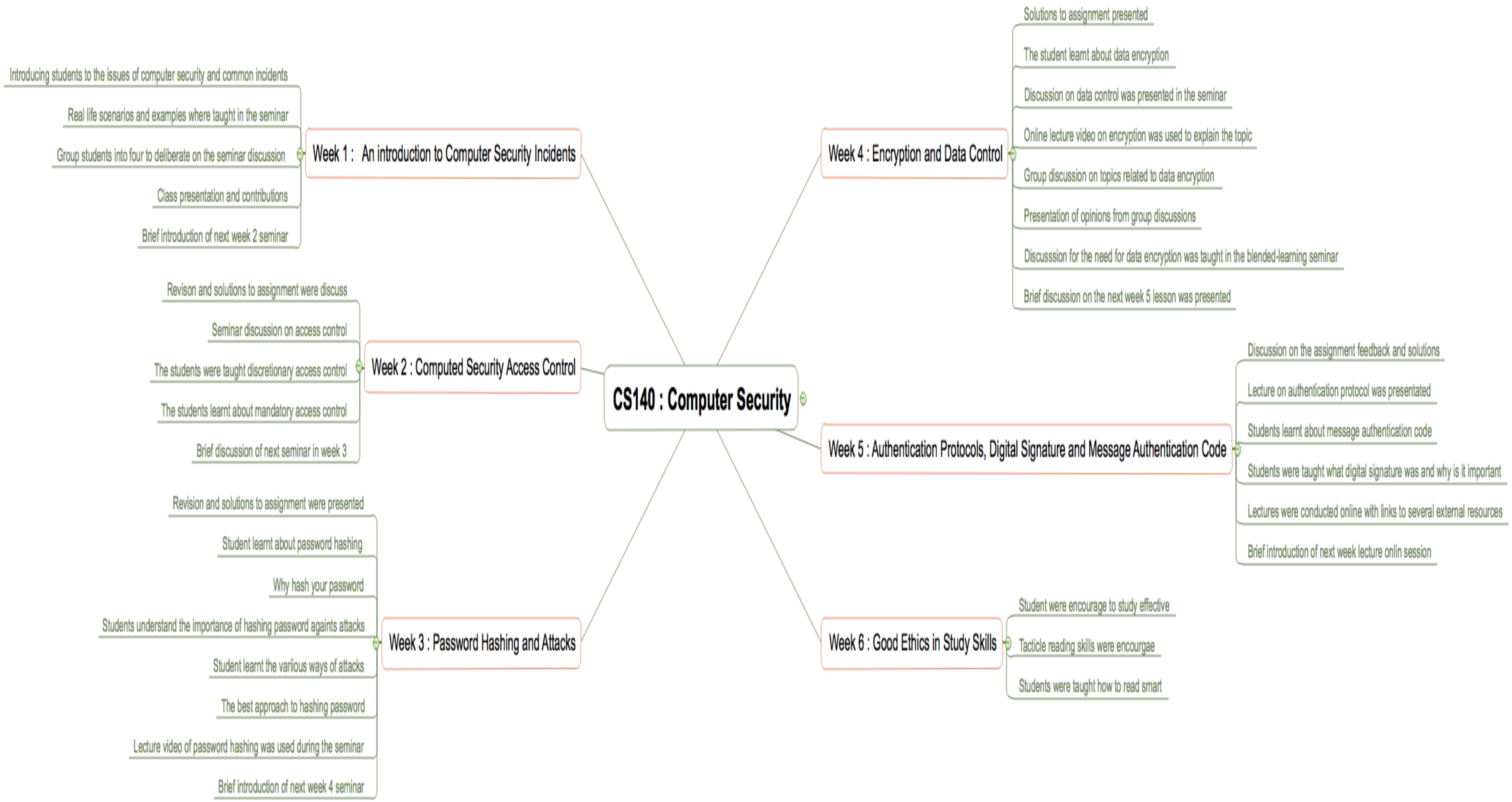

Figure 4.3: CS140 Computer Security (blended-learning course).

4.4.5 Design goals

The main design innovation was to support users in managing their learning if they wished to set and pursue their own study goals. There should still be an option to follow a learning path provided by the course instructor, allowing navigation of the full course in a guided, structured manner to achieve the overall course objectives. Thus, the platform was required to support two modes of learning: a self-directed study mode and an instructor-led guided mode in which the recommended order of topics covers the full course curriculum. To support users' SDL through informed choice, the system should offer advice on (but not enforce) recommended prerequisites for each topic and provide a map for learners to visualise the elements they have studied so far in the learning environment.

Another course developed by other authors was similar; in their case, they applied their prototype tool to automatically map out or highlight geographical entities in texts, which led to and supported the students in acquiring additional information in the same learning environment without disruption [194]. In addition, this could make it more convenient for students to obtain more useful information about their studies, which could motivate and encourage them and, at the same time, could decrease the number of dropouts [336].

The platform should support good data collection and analyses features to evaluate participants' SRL levels, the path followed, interaction log data, attainment, and evaluation responses to aspects such as satisfaction. Since this was both a research tool and a platform for a live course, data collection was a particularly important aspect of the requirements but needed to be balanced with the need to ensure the learners were not over-burdened with feedback requests. In addition to the novel SRL features, the platform needed to integrate a variety of acknowledged MOOC 'good practice' features to support learners and mitigate participant dropout. Again, although used as a research tool, the platform hosted a live course, and it is important to mention that the platform provided a good learning experience for the participants. Some of the features that helped in this experience included, for example, private messaging support for peer-to-peer and student-to-tutor discussion to increase social learning. This was in addition to forums and provided a further support mechanism for students, allowing self-organisation of smaller discussions between those students currently at a similar point. It also encouraged communication for participants who were nervous about contributing to a public forum.

The framework encapsulated a mechanism for instructors to state lesson prerequisites, and these were used to inform learners working in the self-directed mode.

This also provided an additional means for an instructor to monitor the learning progress and study the patterns of learners. The novel features of this architecture allowed participants to self-direct their learning and to receive appropriate instructional support to attain their course objectives, whether this be in reaching goals of their own or undertaking the full course in the instructor-led mode. One of the main objectives of this design was to contribute to the development of elements of motivation in a novel e-learning (MOOC) platform. This is to encourage learners to make informed choices to develop their self-regulated study habits [186]. On the other hand, another very important feature of the learning system is the deployment of elements of lesson prerequisites in the form of content recommendations. The elements in the eLDa e-learning system conceptualised features of a new formal hypothesis to formulate the establishment of a proper design methodology and the analysis of the research.

The modules are arranged in seven sessions (Sessions 0 – 6). The learners had the option to determine the route of study. The self-directed mode allowed the learners to direct their learning. In contrast, in the instructor-led mode, the learners were directed to follow a structured module with prerequisites. The modes were inter-linked such that learners could decide to follow both modes. Learners could interact with the course surveys and quizzes and could obtain course participation badges and a certificate at the end of the course. The approach was validated through experimental research and obtained a good level of precision in the results, as illustrated in Chapters 6 and 7. Our pedagogical goal was to offer learners lesson recommendations regarding the most suitable learning content in instructional learning routes. However, the learners had the choice regarding whether to follow our guided paths or decide otherwise. Figure 4.4 illustrates the overall DSR roadmap [8, 7] and processes involved in this research.

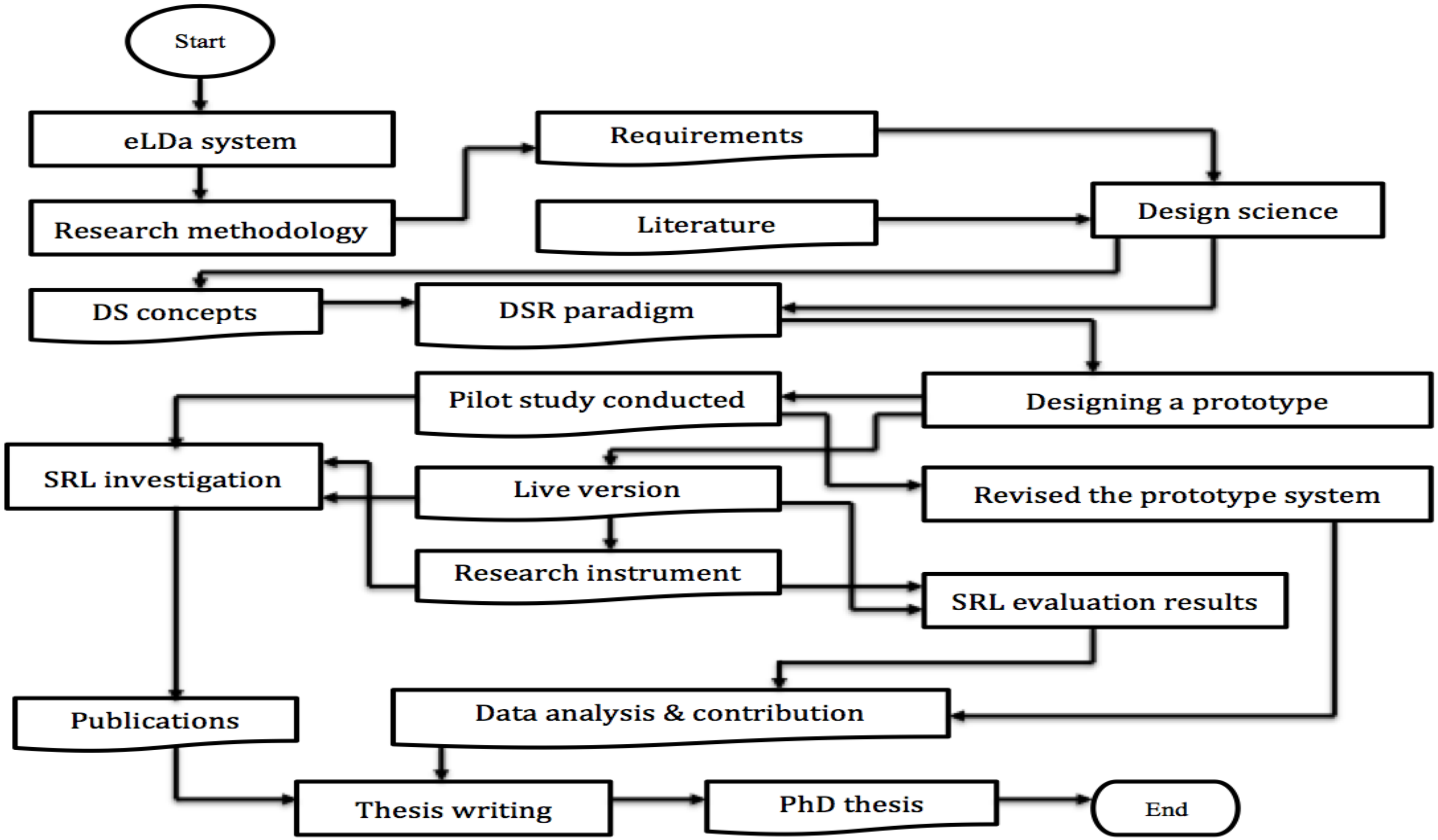

Figure 4.4: Overall research process and design, adapted from Alturki et al. [7].

4.4.6 Description of the architecture

The overall architecture is illustrated in Figure 4.5. When an individual has registered and logs in, they are presented with a map visualising the whole module (or course) showing the sessions and lessons that contribute to the course. At this point, learners can decide which route to follow to attain the optimum benefit from the course resources. The visualisation of the course and the statement of prerequisites support learners in making an informed choice of relating to their initial learning path. This is not fixed, in the sense that a learner can decide at any point to switch between modes, either opting for a more structured, instructor-led path through part of the resources or deciding to set their own objectives and change to SDL.

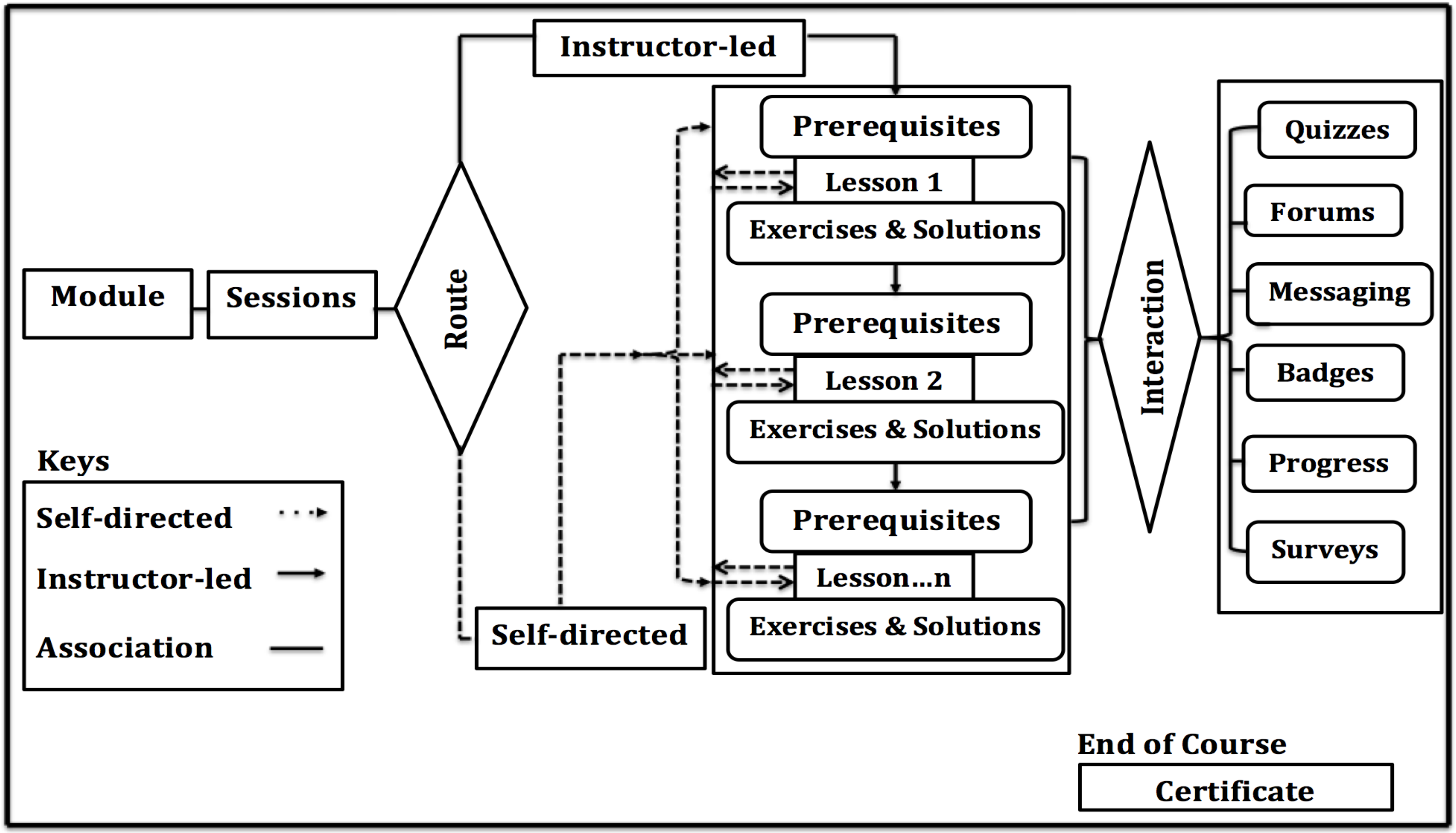

Figure 4.5: Architecture of the eLDa platform.

4.4.7 The learner's route

The dotted lines in Figure 4.5 indicate the pathway for self-directed learners. These learners can move freely from one resource to another without any structure or restriction. Their progress and completion of individual lessons will be reflected in their personalised course map, allowing them at any point to see which areas they have completed. The solid lines indicate the pathway for the instructor-led mode of study. Learners who chose this route were led through the course in a structured, instructional manner. The learners in this route were restricted to following the course resources in a sequential order. While in instructor-led mode, students were required to complete all the associated prerequisites before going forward in the course and in the flow of the study. However, as noted above, learners could decide at any point to switch the learning mode and become self-directed for the remainder or part of their study. Again, this decision was supported by the learner's course map and by considering the prerequisites for different lessons in the course.

4.4.8 Prerequisites rule

If the content of a lesson that a student is engaging with has a prerequisite, then the instructional guidance will recommend the prerequisite to the student to study as illustrated in Figure 4.6 and 4.7. However, if there is no prerequisite, then the student would continue to engage with the contents in their normal study mode. Thus, the eLDa platform can include a large number of lesson prerequisites, which support the learning paths of the participants and help the course instructor monitor and follow the learning progress and patterns of the learners. The effectiveness of the lesson recommendation was measured by the number of hours that the learners spent on the suggested learning resources. This illustrates the suitability of the recommended lesson content to address the learner's real needs. The researcher quantified the time spent in recommended content and non-recommended content. In our case study, it was seen that the recommended lesson navigation was followed to a reasonable extent compared to the non-recommended content. It was observed that advanced learners developed a more effective engaged knowledgeable culture and demonstrated more organised self-regulated skills in the learning platform.

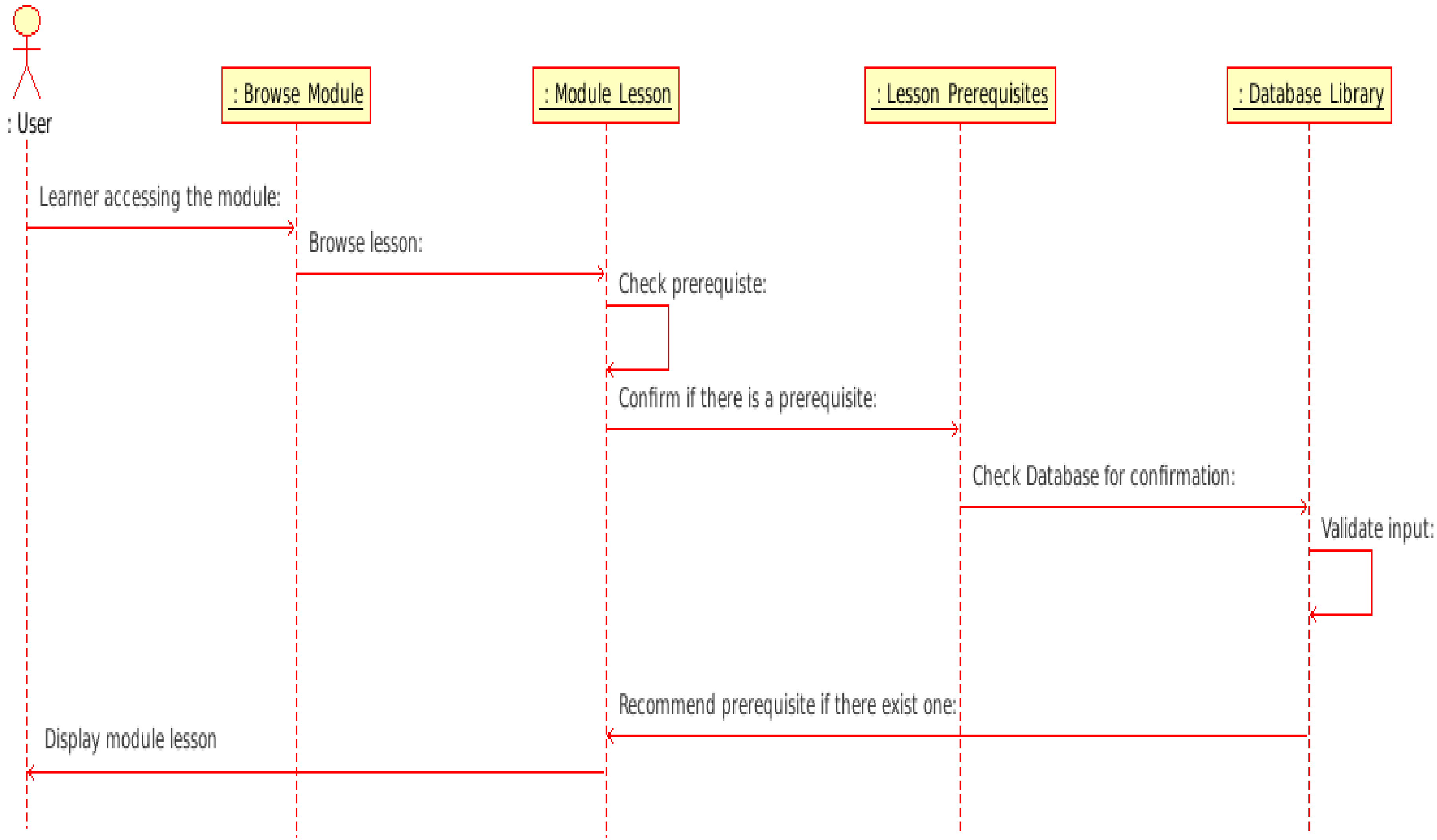

Figure 4.6: Visualisation of the process of lesson prerequisite using a sequence diagram.

Figure 4.7: Recommended lesson prerequisite.

4.4.9 Visualisation and tracking of learners' paths

It should be noted that this research experiment is primarily focussed on teachers of computer science, a few students, and the wider community of learners who might not necessarily be well versed in online learning and web systems. The tool combined both modes of study (self-directed and instructor-led) to foster SRL among the students, as seen in Figure 4.8. Furthermore, eLDa includes tracking of the learning paths of students using a page navigation tracking functionality embedded in the platform using Wordfence and Google Analytics. These plugins help to monitor all the navigated page content and paths followed by the course learners while engaging with the course (as seen in Figure 4.9).

Novel features necessary to the approach were incorporated, such as the provision of information on prerequisites and the use of a road map to allow the learners to visualise their learning paths. Learners response data were collected via built-in surveys, and their activities were tracked using Google Analytics and Wordfence. Similar to many MOOCs, general data on participant demographics, aspirations, and so on was collected via a course entry survey. In addition, mini surveys were used in each session to elicit users' feedback on the resources and the suitability of recommendations made to them by the system. The SRL questionnaire was administered at the start of the course to ascertain the participants' starting levels of SRL skills. Log data were also captured, recording all actions by participants throughout the course.

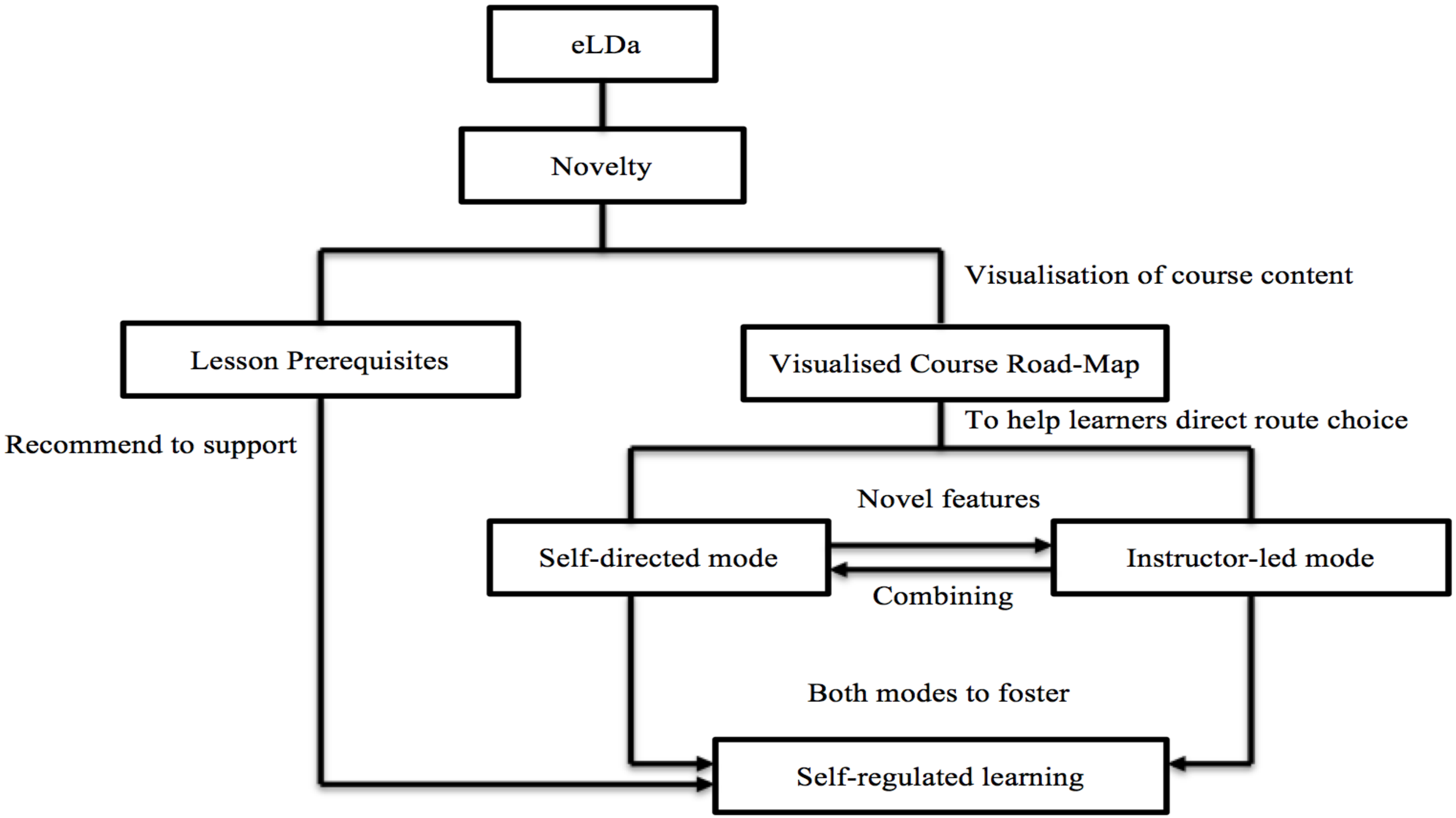

Figure 4.8: Illustrating eLDa novel features.

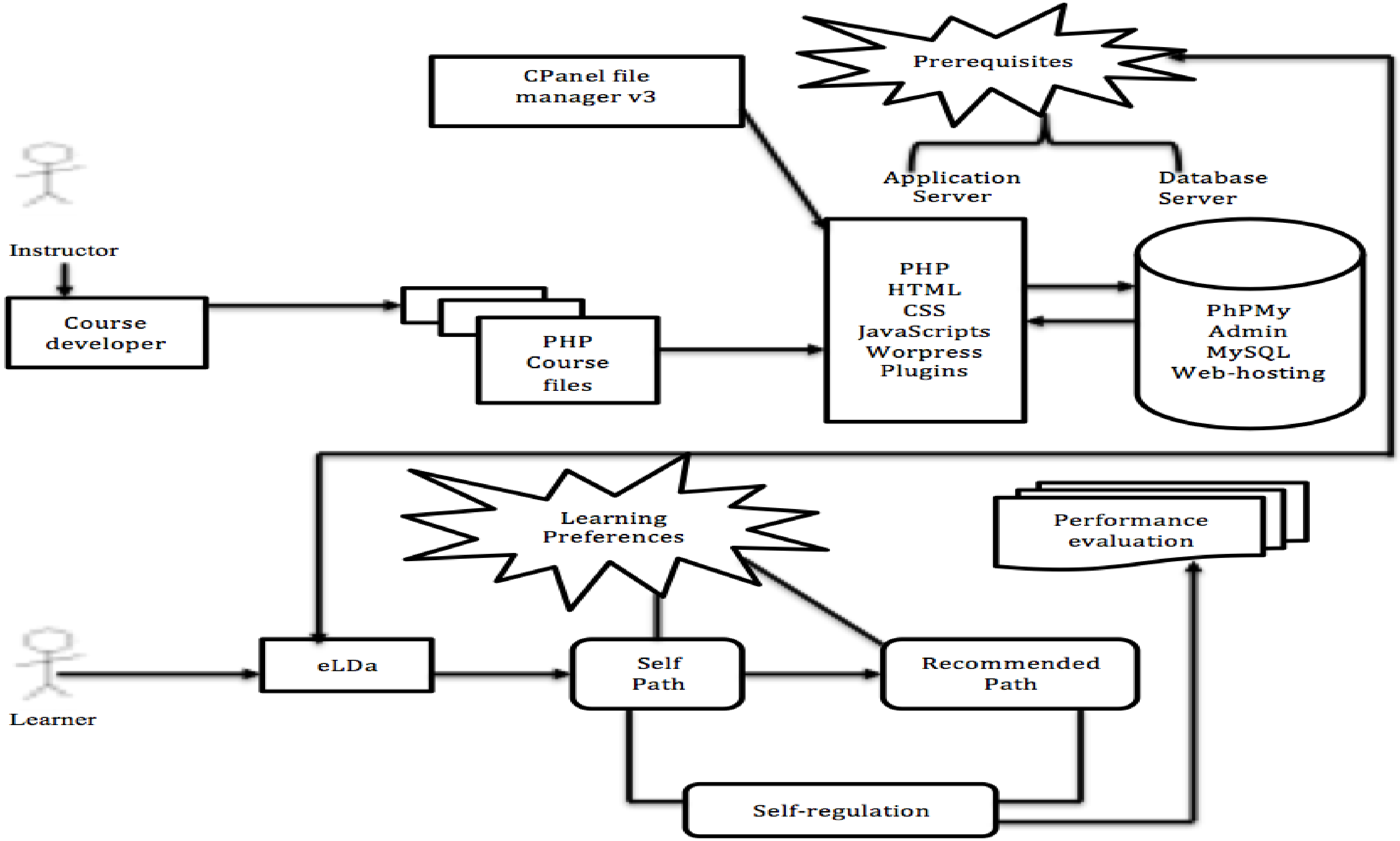

Figure 4.9: The eLDa implementation and process cycle.

Subsection 4.4.10 introduces a blended-learning architecture which is totally separate from the standalone online course. The blended-learning course was created for undergraduate students in order to explore their SRL skills. Full details on how this research was carried out has been addressed in Chapter 7.

4.4.10 Blended course architecture

The overall blended-learning architecture is demonstrated in Figure 4.10. The students were registered to the eLDa platform by the instructor and login details were sent to each student via email. The students were presented with a visual map of the lesson for that week and the previous weeks for revision. The lesson content was delivered every week. Each lesson had class exercises and solutions which were also embedded in the module. Part of the class exercise was done during the blended session and the students could go through the online solutions after the seminar class. Thus, this was another element that intended to explore and promote learner reflection and self-evaluation of their understanding of the seminar lesson. This also enabled students to understand better and encouraged further study.

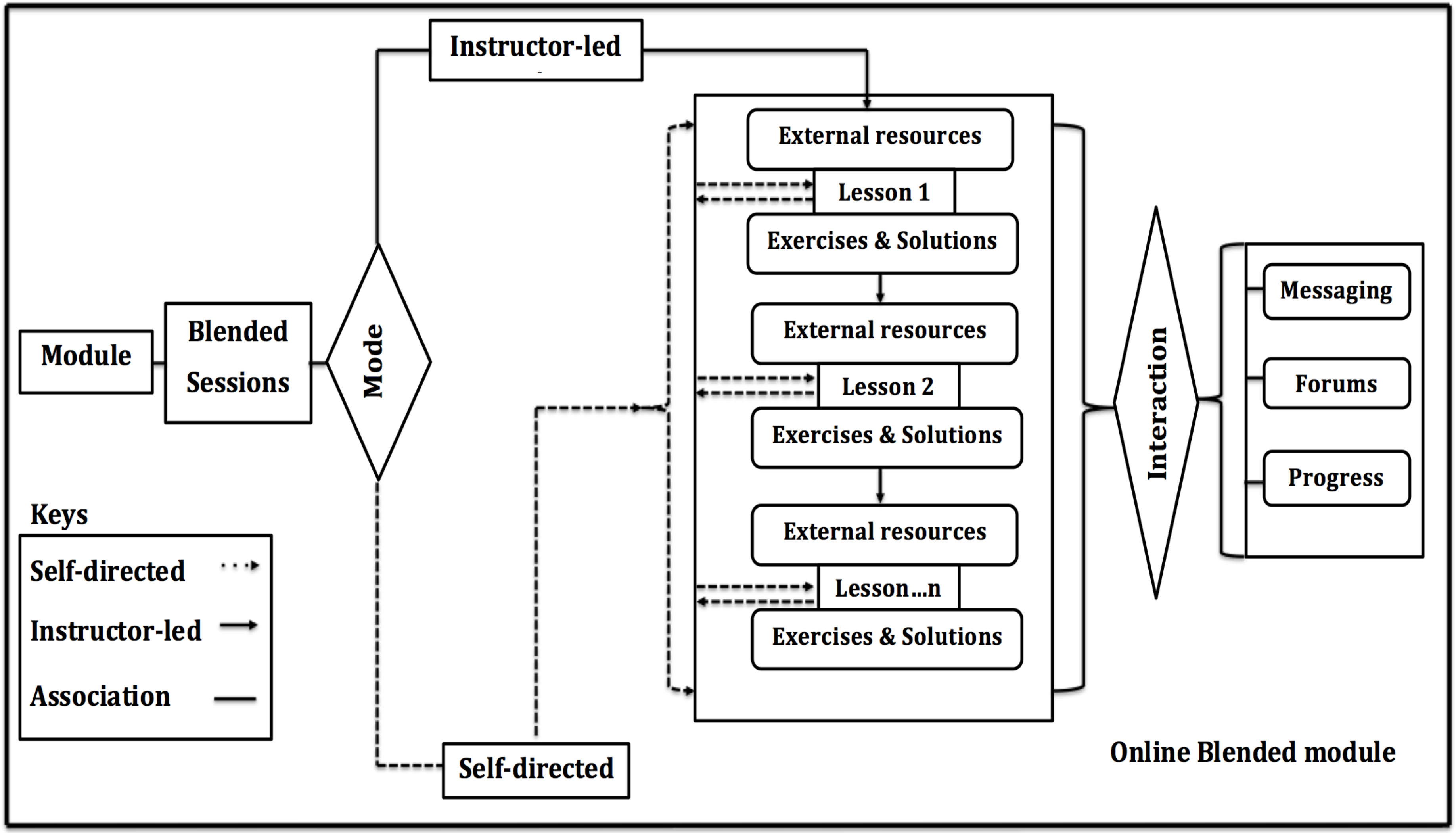

Figure 4.10: Architecture of the online blended module.

4.4.11 Mode of study

The solid lines indicate the pathway of the blended seminar class, as led by the tutor. During the conventional classroom setting, the tutor delivered the seminar using the online blended resources in a structured manner. As observed in most MOOC platforms, there were videos, lecture slides, and links to external resources necessary for more enlightenment on the topic of discourse during the seminar class. This mode of study, as led by the tutor, was incorporated with orthodox teaching to make the lesson more interactive and engaging. The dotted lines in the architecture indicate the student self-directed pathways to study after the blended session. The students self-directed their learning in this case, and they decided on how to engage with the course at an individual learning pace. They could self-direct their route to go back to previous lessons to acquire more knowledge to have an optimum understanding of the current lesson. The students were encouraged to study the materials before the next lesson. These materials, as previously mentioned, were uploaded online every week, and private messages were sent to all participating students via the eLDa platform embedded email system.

Messaging: Private messaging was another vital and useful resource to motivate and encourage shy students to communicate with the tutor privately and seek assistance in the module. The platform introduced an instant messaging system that sent a message to the tutors' personal email and private forum notification embedded in the learning tool. Students, on the other hand, could send private messages to peers in the seminar class and seek help with their studies.

Forums: After the blended class, the students could engage with lessons and share knowledge using the discussion forum created for this module, as embedded in the eLDa platform. This describes the introduction of students' learning engagement in the form of a discussion community developed specifically for the module. This forum enabled the exchange of ideas about the module and weekly assignment or exercises. Our observation shows that most of the students who constantly engaged and participated in the community forum found it beneficial. The tutor also used this forum to communicate with the students and provide support with external resources suitable to aid in conventional assessment.

4.4.12 Interactive support

All learners on either mode were supported by several features that were regarded as general good practices within MOOCs. These features are associated with increased motivation and promote learner interaction and engagement. The following elements were incorporated.

Quizzes: These allowed learners to evaluate their understanding of the course concepts. They also provided instructors with information on learners' progress and formed the basis for awarding badges and certificates.

Exercises and solutions: Each session and lesson (apart from the introductory one) had programming exercises and model solutions embedded. This was another element that supports learners' self-evaluation of their understanding. Providing model solutions for the programming elements allowed students to work through (at least to some extent) problems in programming and to compare their solutions.

Forums: This interactive component enabled learners to seek help from peers and tutors. It also encouraged active participation and engagement, both through the act of asking questions and through suggesting answers and contributing to the general discussion of course issues.

Badges: Digital badges have been shown to provide an incentive that (for some learners at least) acts as a motivating factor and encourages participation. Badges are awarded when a learner starts the course and when they complete a lesson. Learners who completed the full course (following whatever mode) were awarded a certificate of recognition.

Progress map: This provided the learner with an individual visualisation of the completed lessons and sessions. It indicated the concepts already studied and showed the topics left to complete. This component helped direct and support learners in identifying their next step and accessing the appropriate resources quickly. To support the students in following the lessons in an orderly manner and to show those not yet studied, a visualisation of the lesson component was incorporated in the blended module. This visualisation provides students with an individual view of the completed lessons and those yet to be studied. Figure 4.11 illustrates a progress map of a session in the eLDa platform course. This was to support rerouting and directing the students to the next lessons promptly without any wasted time.

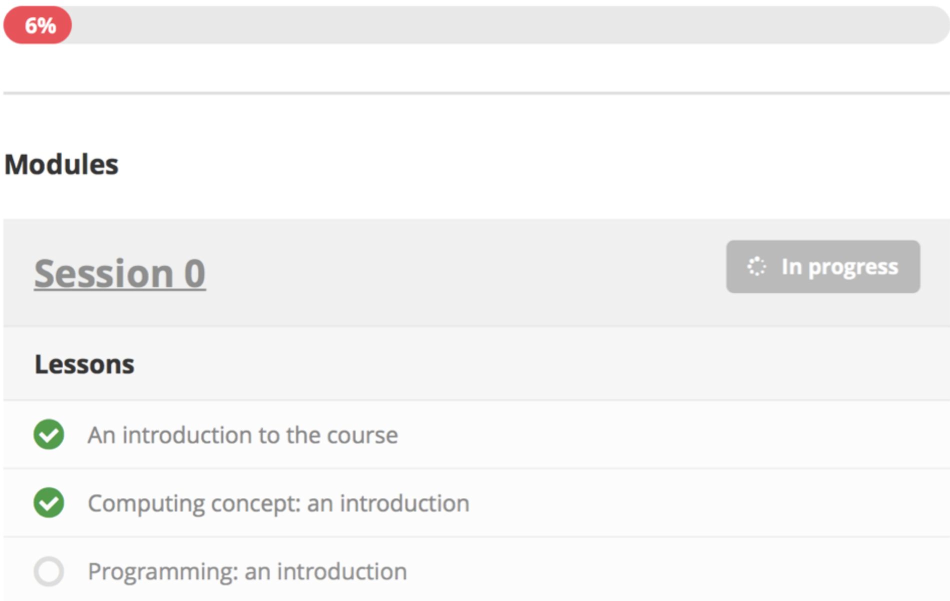

Figure 4.11: Visualisation of course elements to support rerouting to the next lesson.

Surveys: These are vital for the collection of data related to learner demographics and course satisfaction. However, they are also important elements of SRL for the learners, encouraging respondents to reflect on their learning and to be active in reviewing the provision of the course and influencing its direction for future learners. This research viewed active learning as learners engaging with the introduced interactive features, such as discussion forums and engaging with course quizzes, surveys, and so on. The learners also interacted on a one-on-one basis with peers and tutors for support, as illustrated in Figure 4.12.

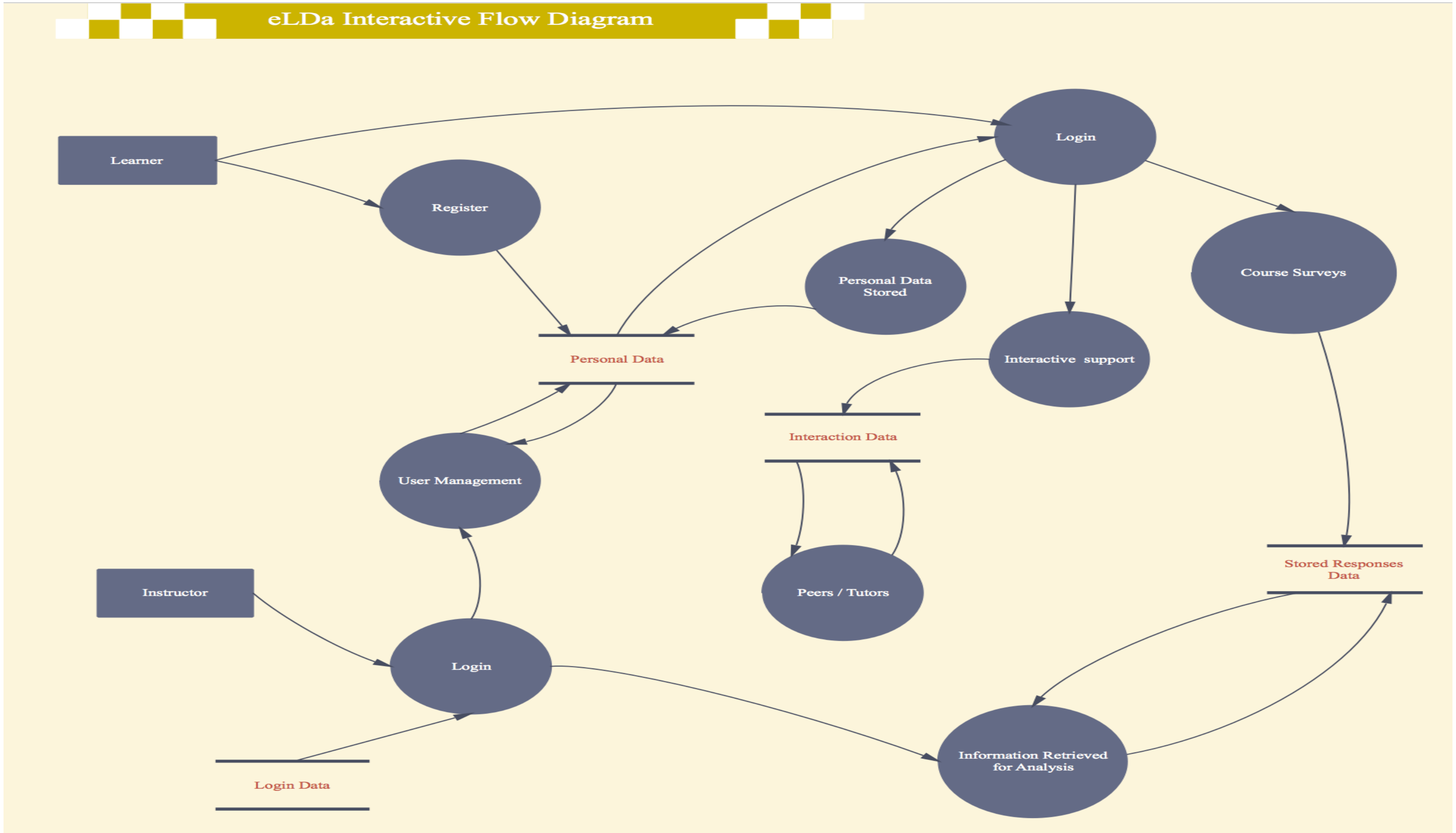

Figure 4.12: Interactive learning and support.

4.4.13 Testing and implementation

As described earlier in subsection 4.4.1, the eLDa course platform was designed and implemented using WordPress - which is a free open-source CMS developed based on PHP and MySQL. The choice of WordPress for this study was motivated by its suitability for incorporating the novel features of different learning modes and paths and for allowing the representation of learning prerequisites via compatible plugins. Before choosing WordPress as our final platform for this study, several other LMSs were investigated. Despite their advantages in terms of learning support functionality, their structure made it more difficult to implement the novel features of the eLDa architecture. WordPress, in this case, allowed a prototype (yet robust) system to be developed relatively quickly. For example, as illustrated in Figure 4.13, WordPress created a visual representation of the course content for mapping the session and lesson structures. This visualisation enabled the learners to view an overview of the content and a representation of their own progress in a clear and simple manner.

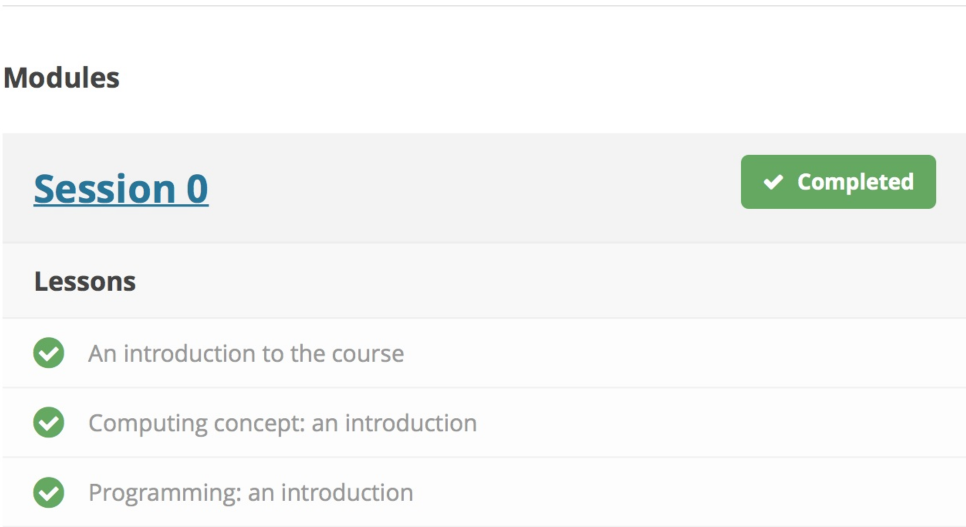

Figure 4.13: Visualisation of completed course elements.

4.4.14 Frontend and backend design of eLDa

The eLDa course platform was designed and developed using the WordPress LMS. Some PHP plugins were introduced to support the functionality and features of the learning system. The Sensei plugin was used to create the course content and lesson prerequisites, while Wordfence and Google Analytics were applied to capture the learner analytics both in real time and for the event log interaction. An Apache web server and Macintosh Apache MySQL PHP (MAMP) were used as the hypertext transfer protocol (HTTP) web server localhost and MySQL 5.5.42.cll.lve was used as the database management system (DBMS). The server localhost was via a UNIX socket (UNIX is a multitasking, multi-user computer operating system and open-source software), this as being part of the iOS. This was later migrated to the web-hosting server using PhPMyAdmin. For MAMP, Macintosh is the operating system, and Apache was the web system, while MySQL was the database server.

Finally, PHP was a module contained in the web server, as illustrated in Figure 4.14. By definition PHP stands as hypertext preprocessor, and is a server-side scripting language designed mainly for web development and application but is also applied in most cases as a general-purpose programming language. Regarding MySQL, this is pronounced 'My Sequel', and is an open-source relational database management system (RDBMS). MySQL is written in the C and C++ programming languages. It is a server-side database application that works on several operating systems and platforms, such as UNIX, Macintosh operating system (Mac OS), and Windows among others. It is mostly used in web-based and embedded applications. Cascading Style Sheets (CSS) is a style sheet language that was used for defining the style of the external web pages, setting the visual style of the course design interface and aligning the layout of the WordPress theme that was used. It is also used for describing the presentation of document that was written in a markup language. HyperText Markup Language (HTML) is the standard markup language for creating the course web pages and supporting the web applications.

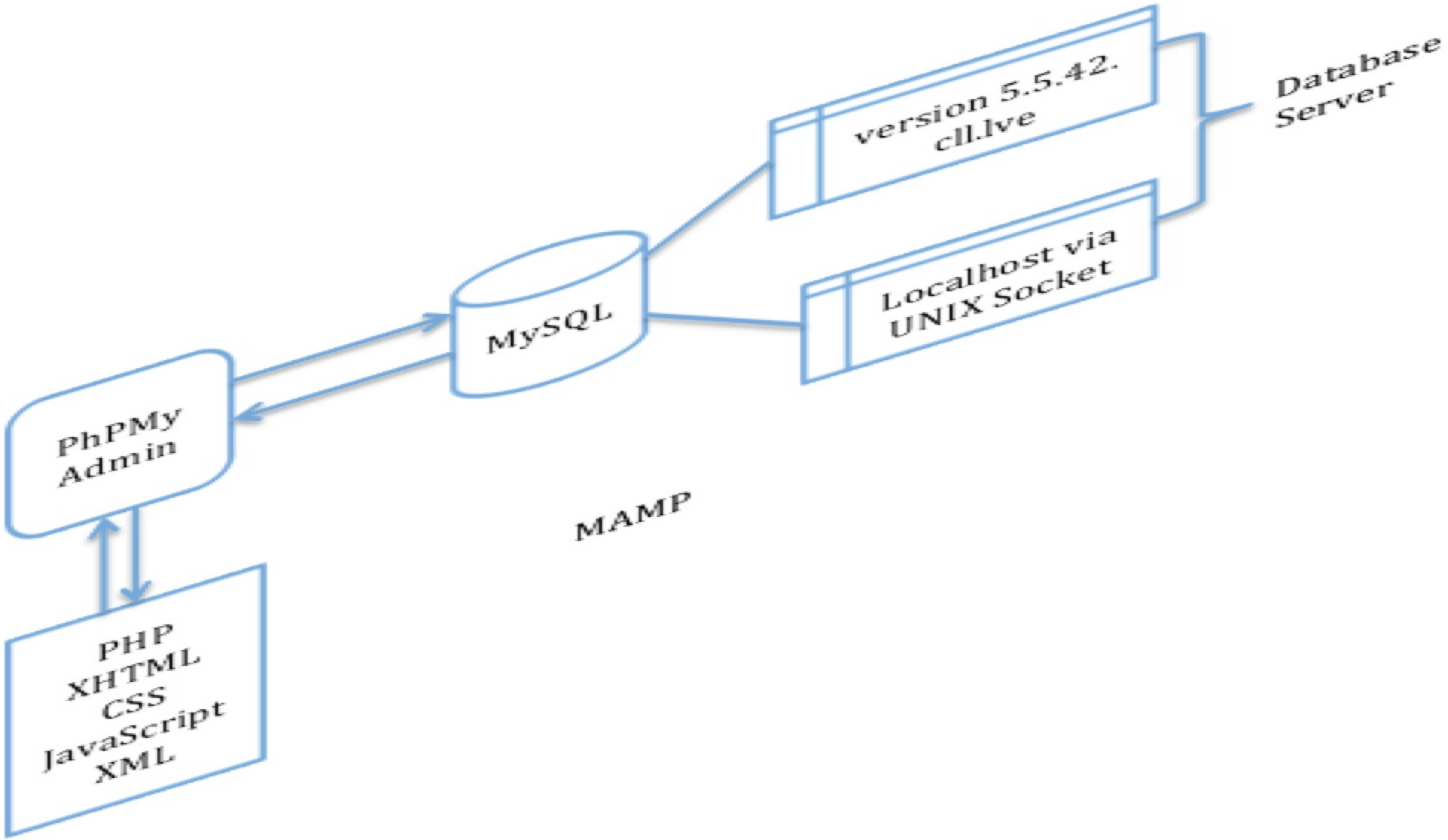

Figure 4.14: Application server and database server application.

4.4.15 Use cases and class diagram of the eLDa platform

Representation of the processes of accessing the course is described using use cases and a class diagram. Figure 4.15 represents the conceptualised class diagram of the platform. Figure 4.16 shows the processes of gaining authorisation for the platform to access the learning resources. Figure 4.17 shows the learning paths offered to the registered learners to help them to decide which option to follow to attain optimum success in the course. The course author and instructor managed the learners. There is a limit to the accessibility and privileges given to participants, for example, learners are not allowed access to the course dashboard which was where the course content was created, and are not allowed access to the back-end database site. The instructor limits the functions of each user to the course interface. Full access control is restricted, and only the instructor can close, delete, and add new user accounts (as seen in Figure 4.18).

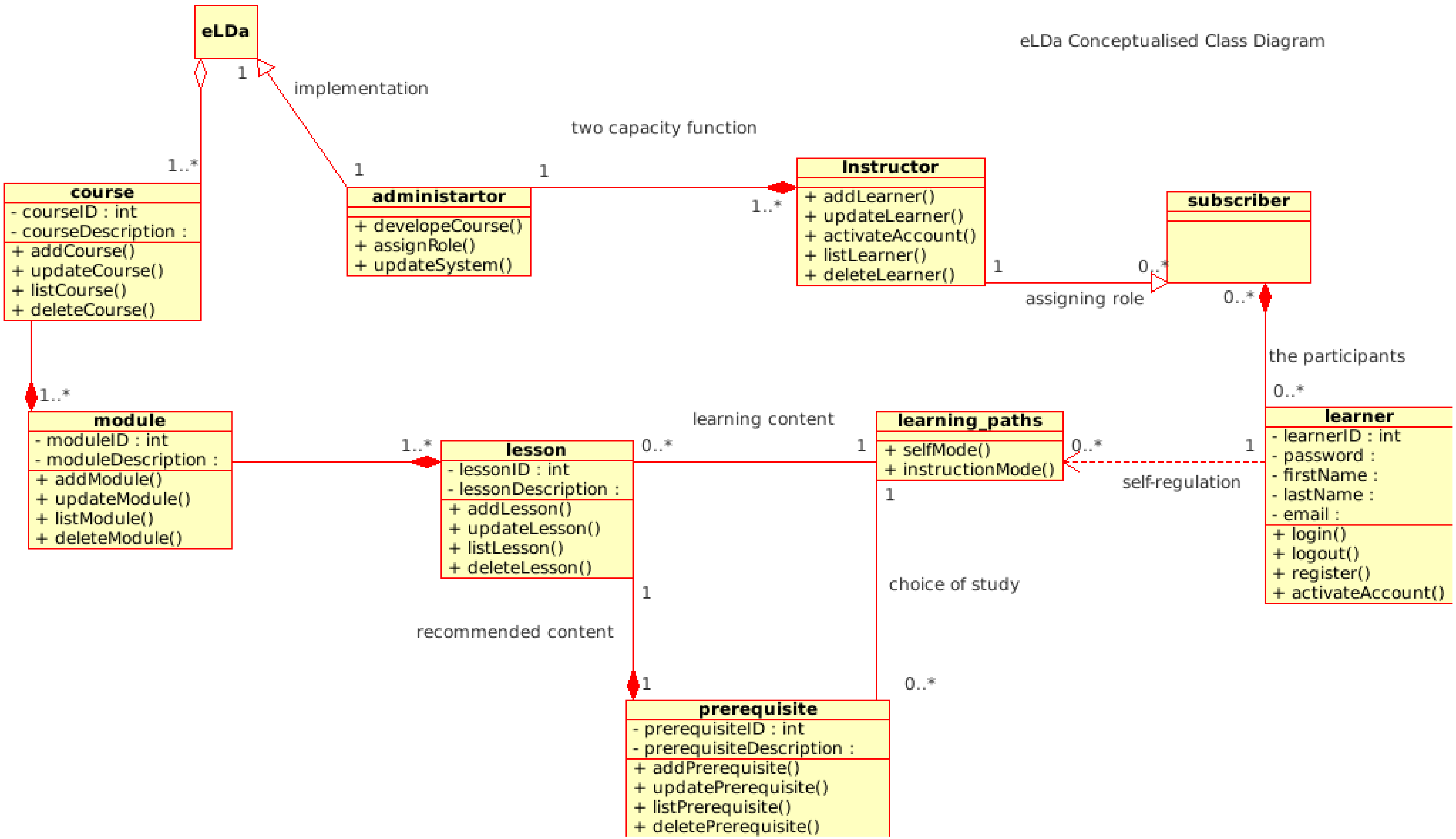

Figure 4.15: The eLDa conceptualised class diagram.

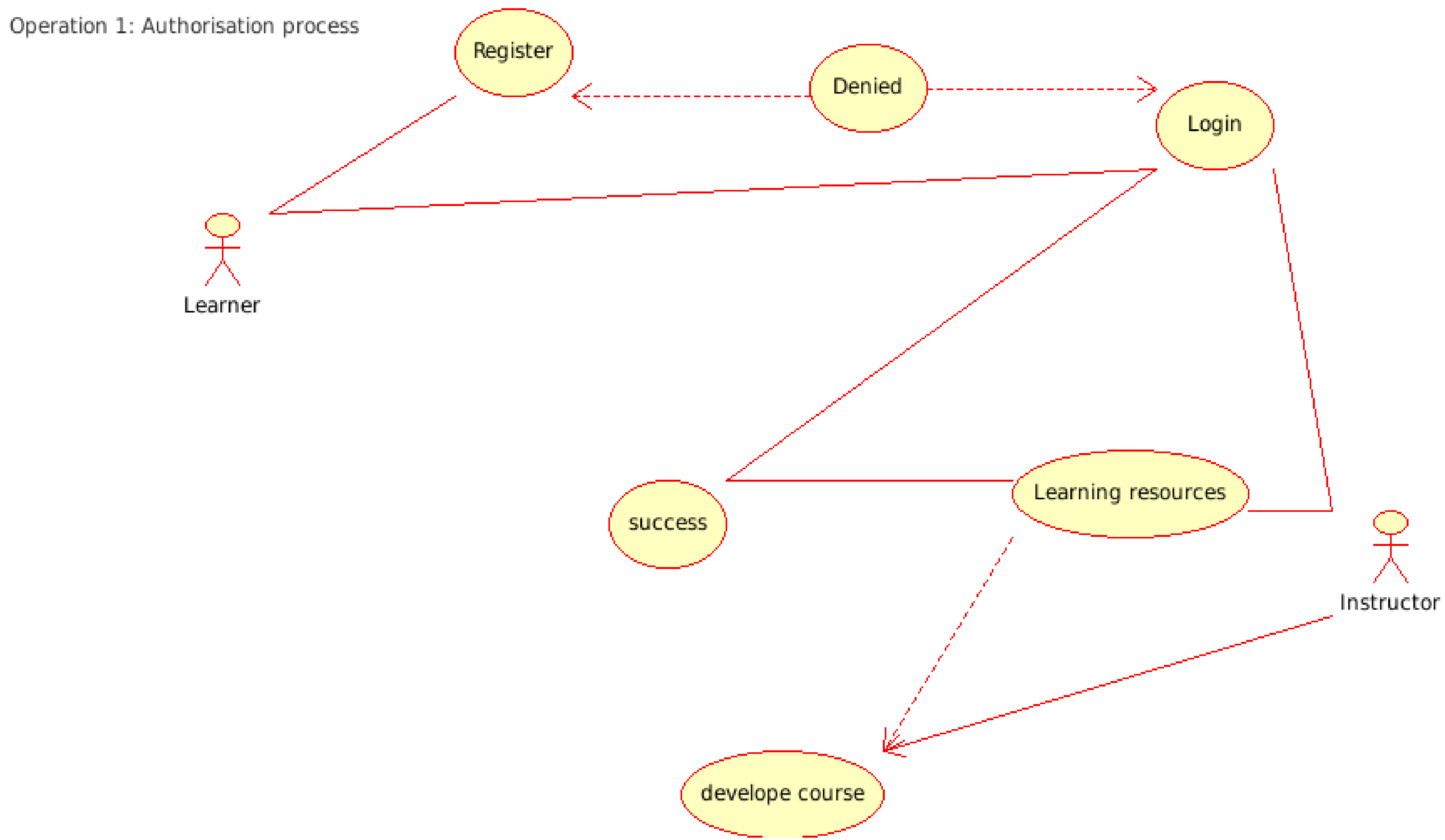

Figure 4.16: Login authorisation processes.

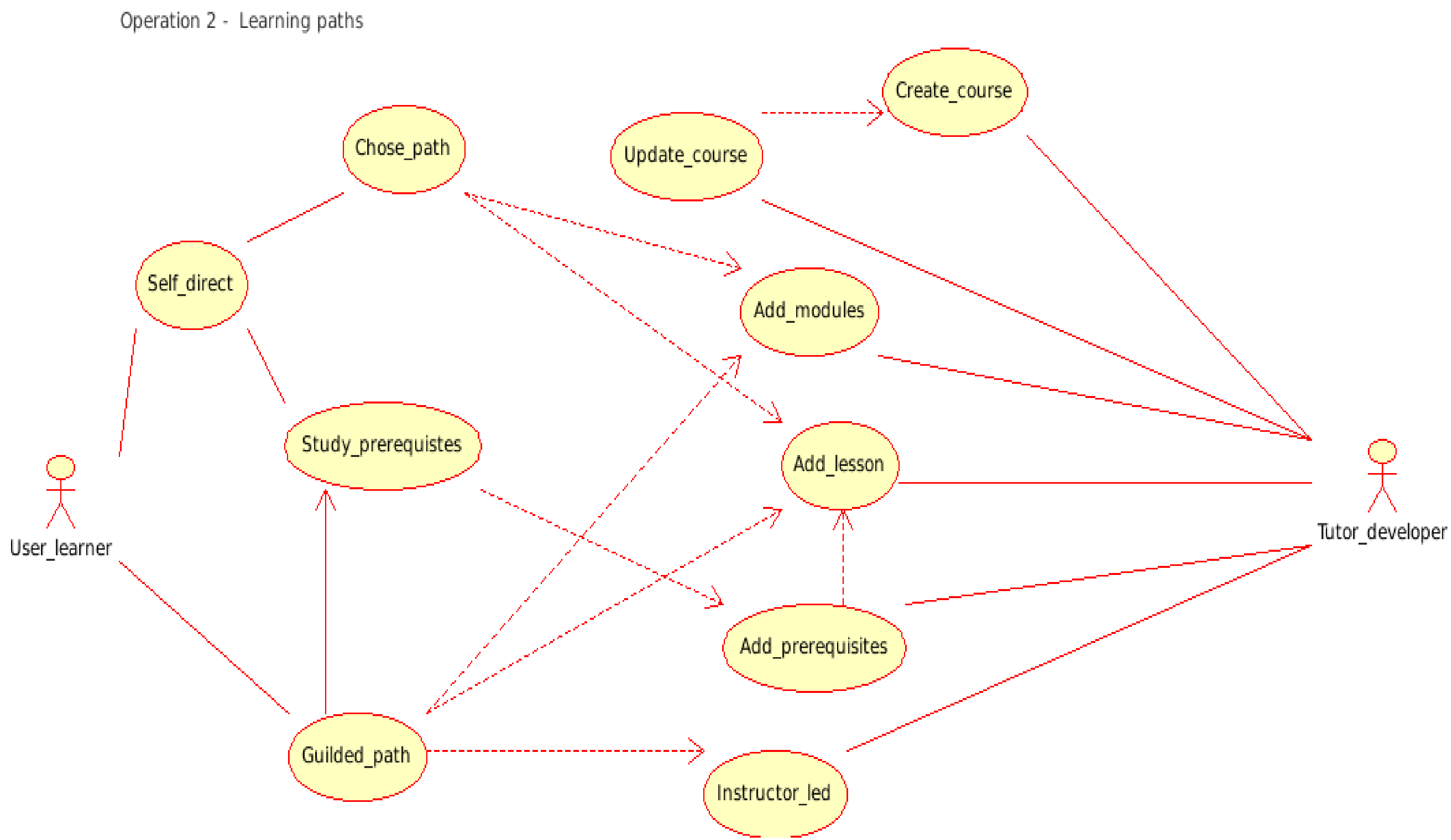

Figure 4.17: Deciding learning paths.

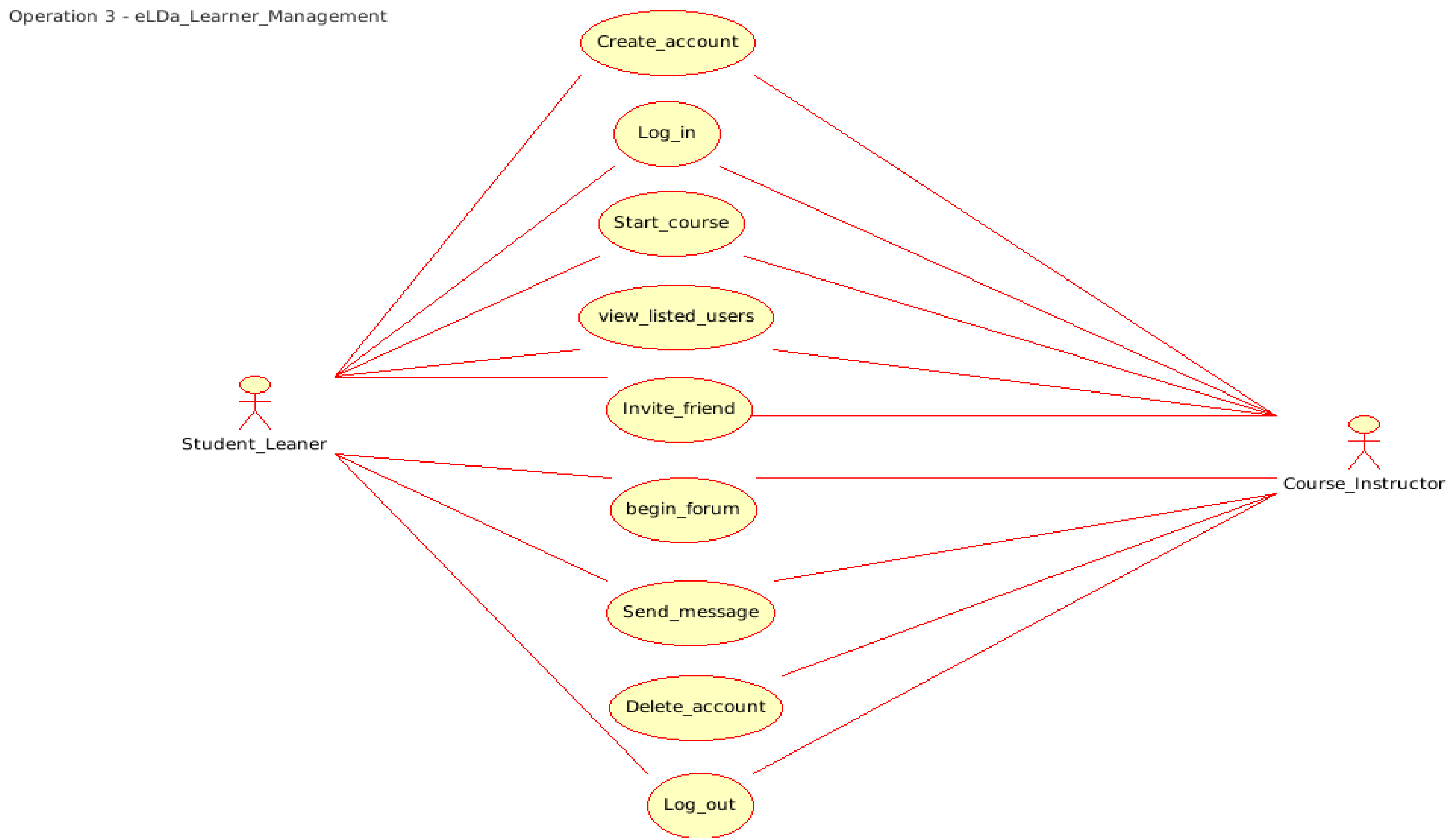

Figure 4.18: Learner control and management processes.

4.4.16 Accessing the system

The eLDa learning system has been developed to meet learners' needs. The idea was to design a self-directed mode and instructor-led support mode of study and a means of communicating with the tutor using private messages to resolve any learner concerns. The course has two main unique features in the self-directed mode of study, and the instructor-led system support in the form of content prerequisites. The preliminary results from the eLDa MOOC platform were retrieved from two cohorts. The first trial course cohort had the two modes of study: self-directed and instructor-led system prerequisites. The second trial course cohort did not have the system led prerequisites; hence, learners engaged with the course in a blended-classroom setting and followed the course in a weekly seminar structure. The course has been developed to be learner centric in order to be adaptable to the participants [210]. Learners have to register to gain access to this course or else access to the learning resources will be denied as seen in Figure 4.19.

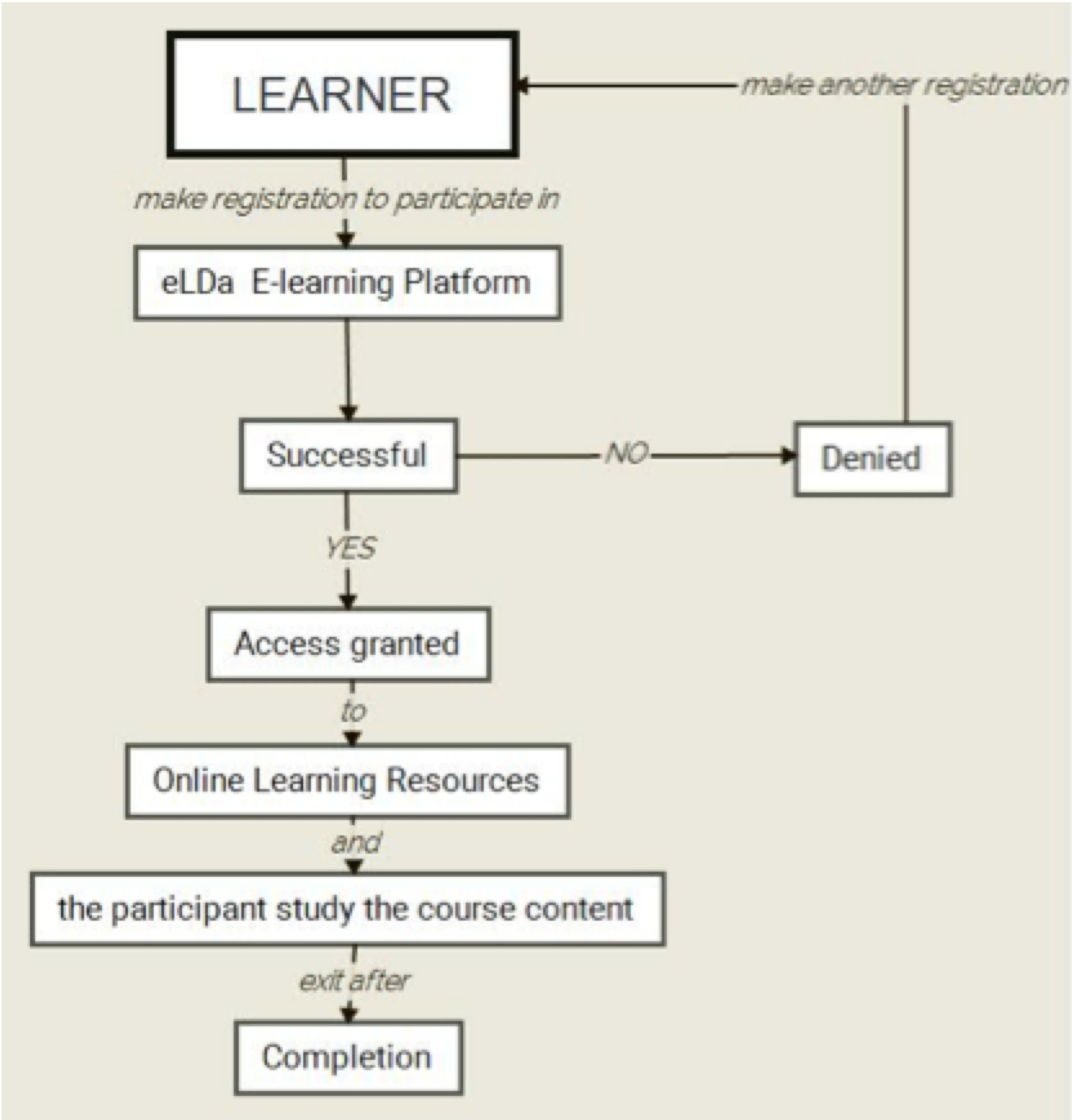

Figure 4.19: Process of accessing the course.

4.4.17 Process life cycle

Figure 4.20 shows a client accessing the course components and structure of the course as a design for learner engagement. The request from the user passes through the web server at the interface to the backend application server that contains some server programming languages (PHP, HTML, CSS, and so on), which are connected to the database at the backend. The database designed in MySQL receives the requests and processes the instructions initiated by the learner in the application server languages. The application server retrieves the information from the database server, and the learning content is sent to the client (learner) system through the Internet.

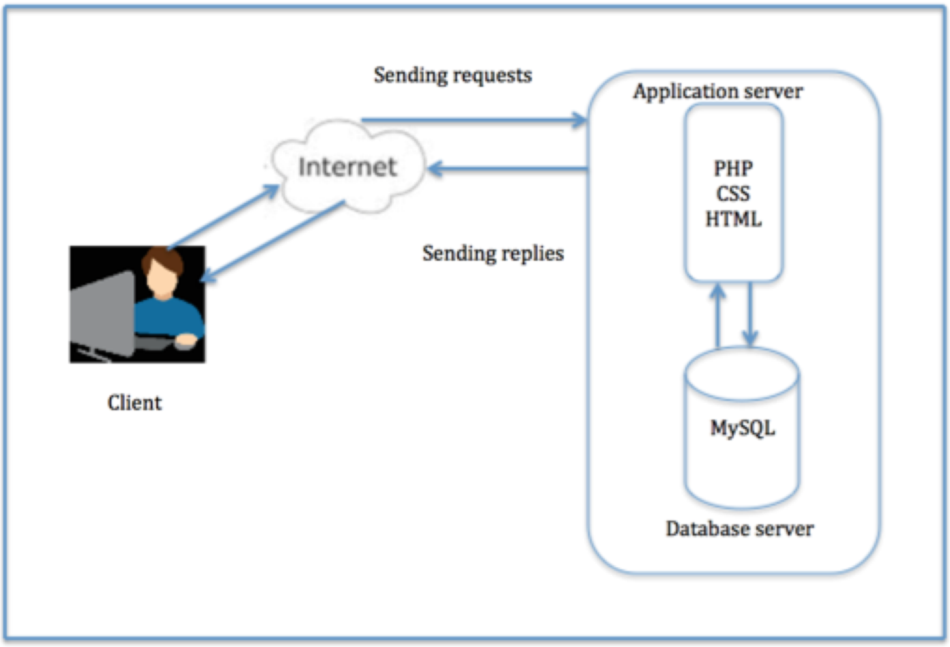

Figure 4.20: The eLDa client and server architecture.

Figure 4.21 provides further explanation of the application and database servers processing requests from the learner. At the first level, the learners access the platform by requesting course content through the visualised resources. The request then passes through sequences of processes in the second level. The request is retrieved from the database after the query was executed successfully. During the query of the request, the database reviews whether there are required prerequisites. If there are any prerequisites, the system will then provide recommendations as needed or display the content requested and allow the learner to proceed with their studies in the chosen mode.

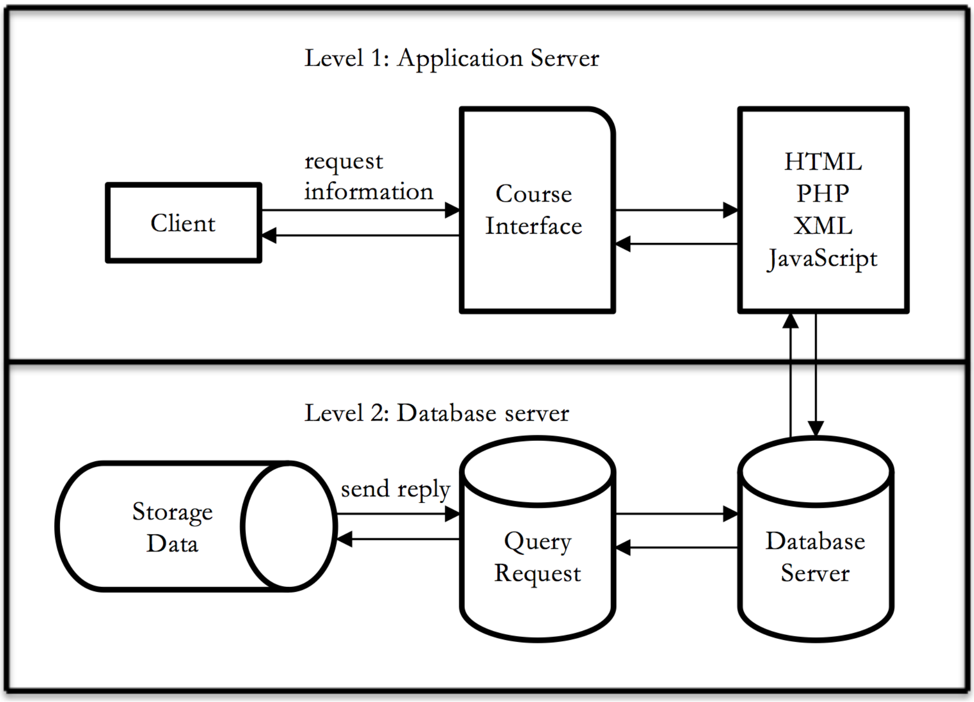

Figure 4.21: Visualising information request process.

4.4.18 Objectives of the course pedagogy

This section addresses the objectives of the design goal used for supporting the learners in this course. A new approach to learning which supports and leads learners to make their choice of learning was designed. To create a learning platform with high visualisation and connection between the topics and the high-level goals of the course programme, the course must be explicitly visible [13]. The tool was designed based on a pedagogical curriculum, with the following selected features in mind.

- The course is visible at first glance after login, which shows the kinds of skills or knowledge that the students intend to obtain after course completion.
- The lesson prerequisites are created within the learning outcomes. This dependency links the learners directly to the necessary lessons for which they were expected to study before proceeding to the next lesson. In other words, the students are guided in an instructional manner to acquire the full knowledge of the course pedagogy.
- The course programme and topics were displayed in full view for the learners to decide on their choice of study routes.

- Interactive components, such as quizzes, questionnaires, and surveys were embedded in the course to gather information with respect to the understanding of the learners and to be able to identify whether the ability of SRL could be present or identified.

Figure 4.22 shows the administrator dashboard where all the course designs and prerequisites and other activities are created and monitored. Figure 4.23 shows the visualisation of all courses offered to a learner in the platform. The next interface in Figure 4.24 illustrates a visualisation of a single course and some online participants taking the course. The display of learners online is to foster interaction among the participants. Figure 4.25 displays a road map of the lessons completed in each session. This feature was introduced to support the learners in making self-directed decisions on the next lesson to study. It helps to reduce time waste in searching through all the courses. The process supports the time management skills of the learners. This was one of the six SRL dimensions described in this thesis. Figure 4.26 illustrates a course interface showing; start a course, contact course tutor, and a badge earned. Learner's badges are awarded as soon as they register and engage with a lesson.

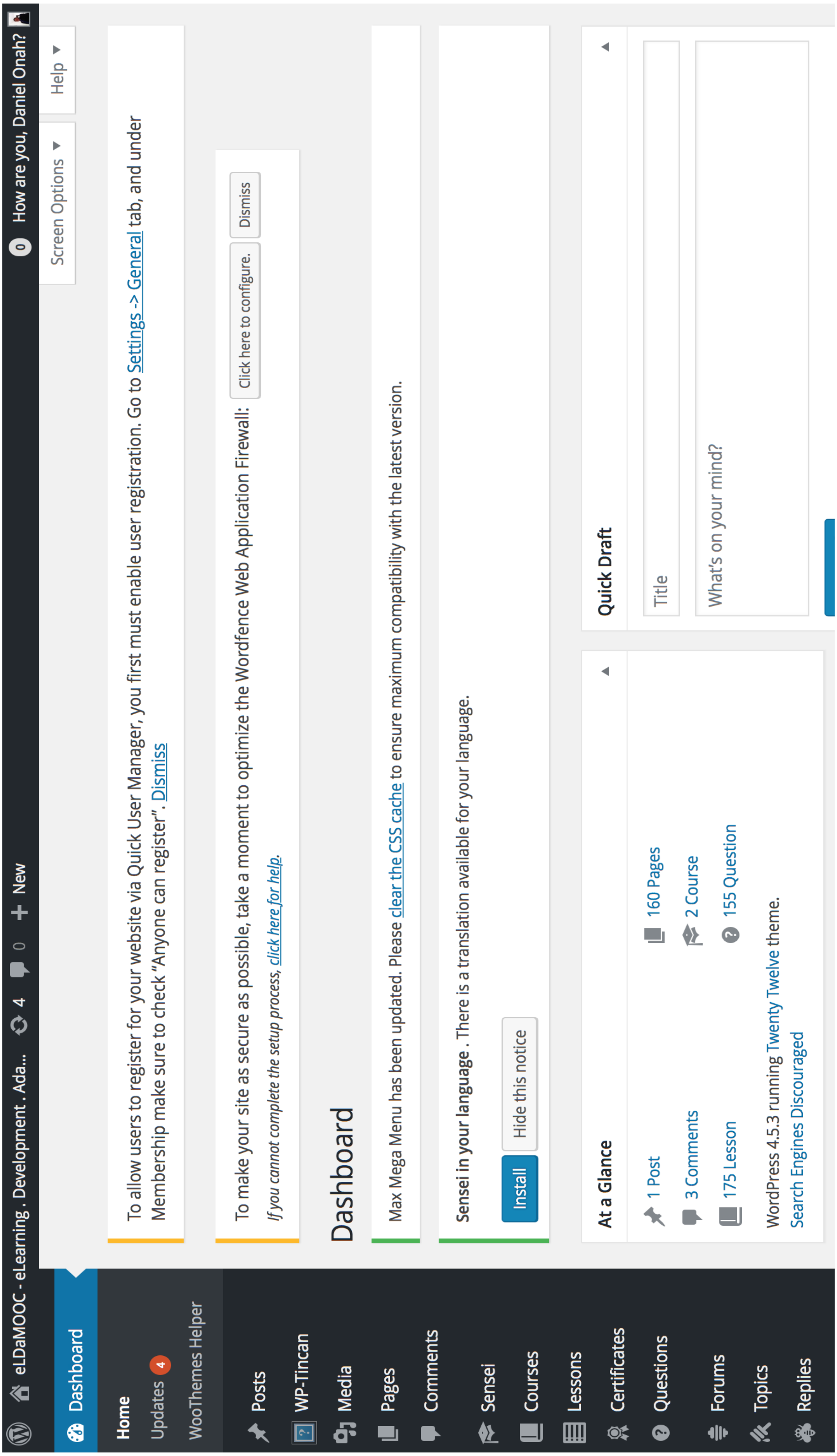

Figure 4.22: Course developer and instructor dashboard.

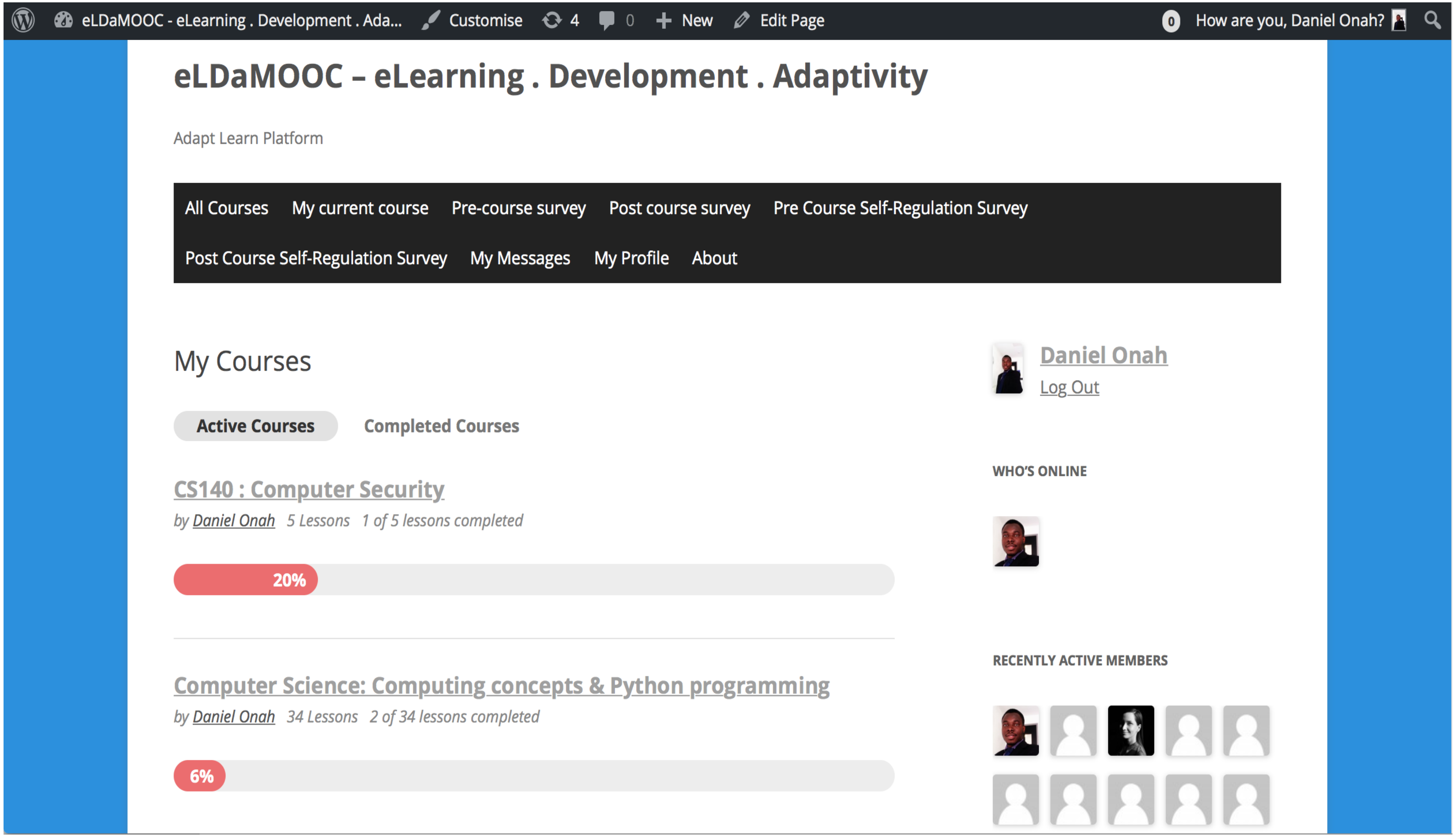

Figure 4.23: Visualisation of blended-learning course and standalone online course.

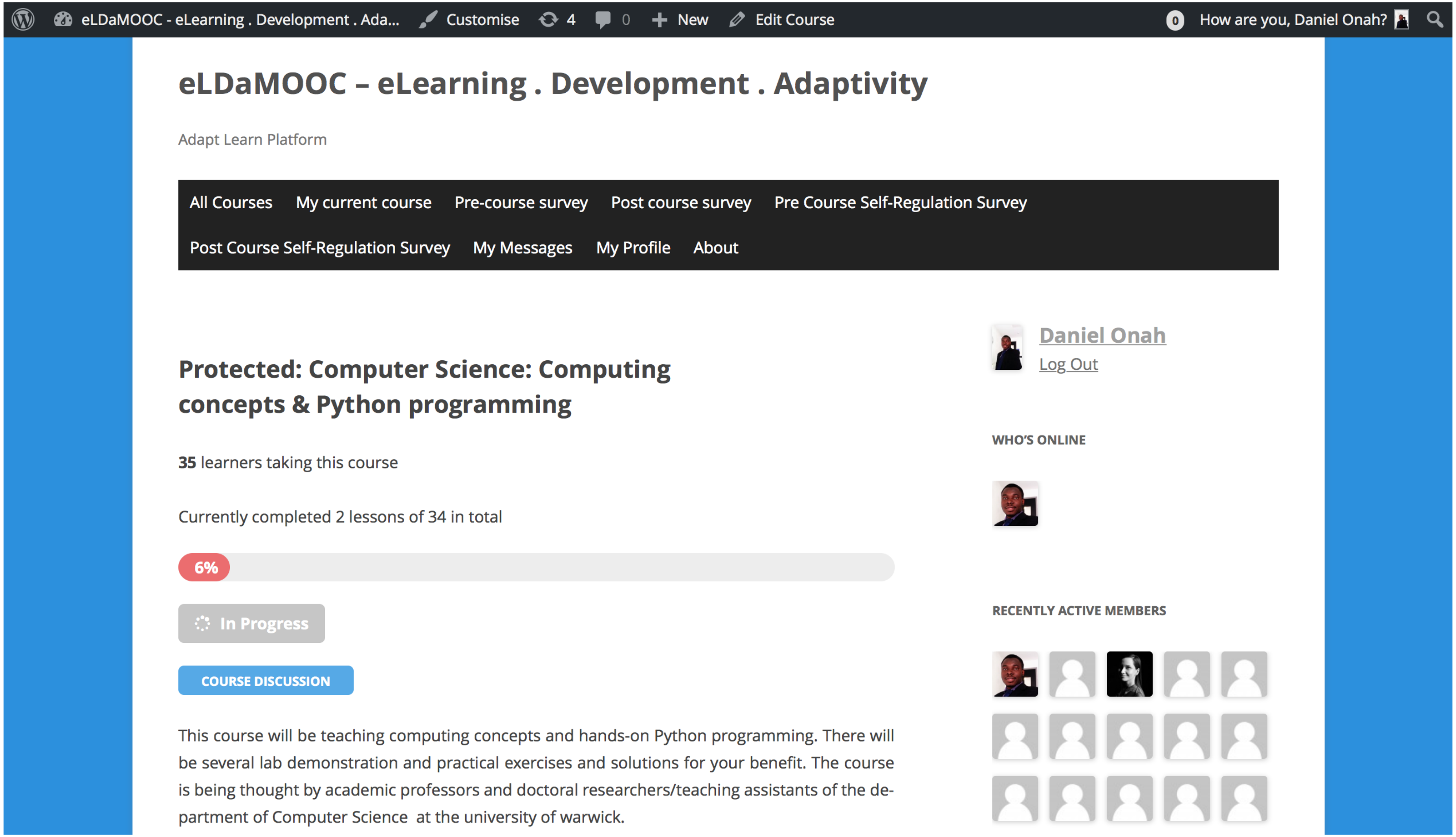

Figure 4.24: Visual representation of a single course.

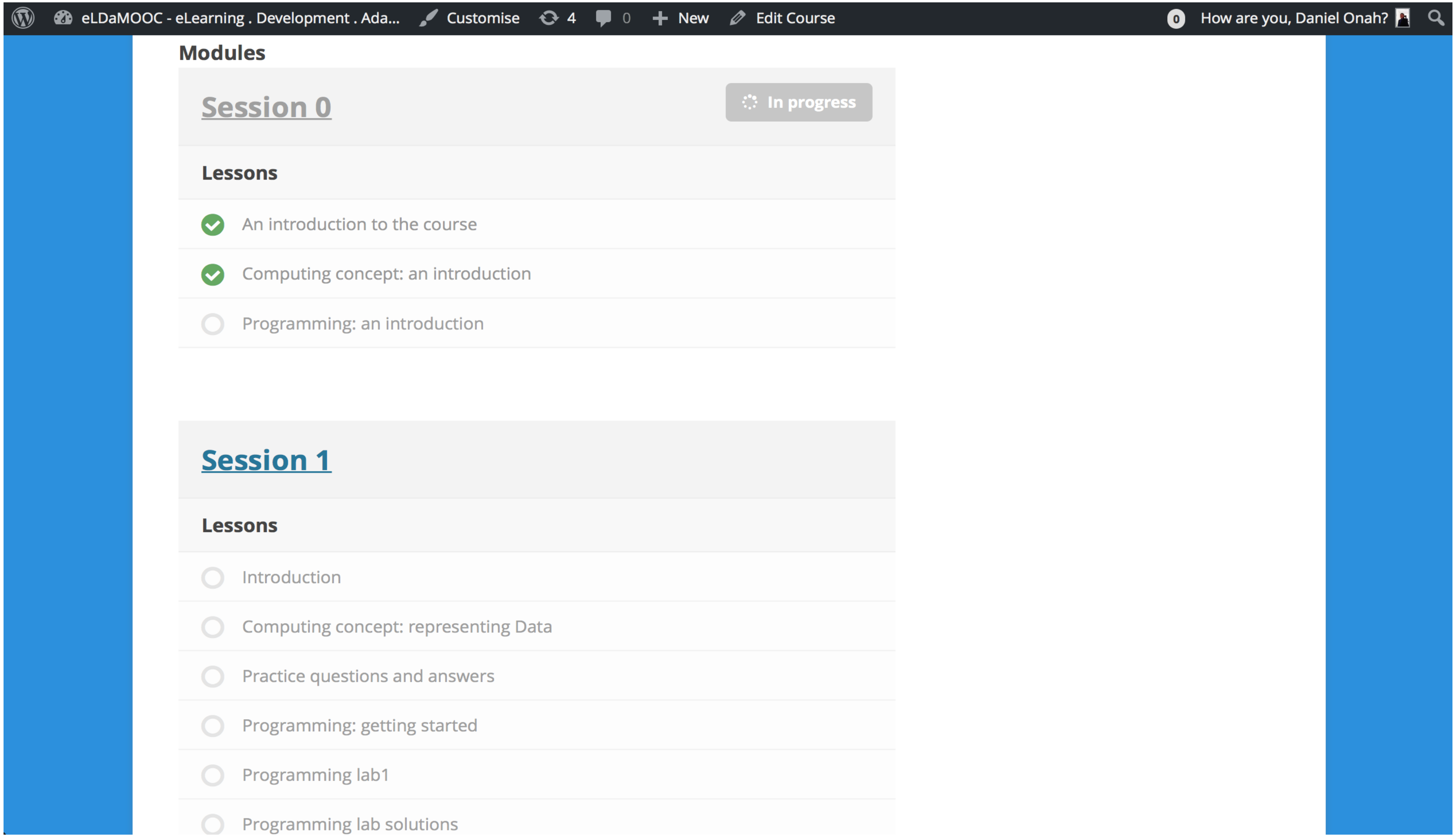

Figure 4.25: Visualisation of course sessions.

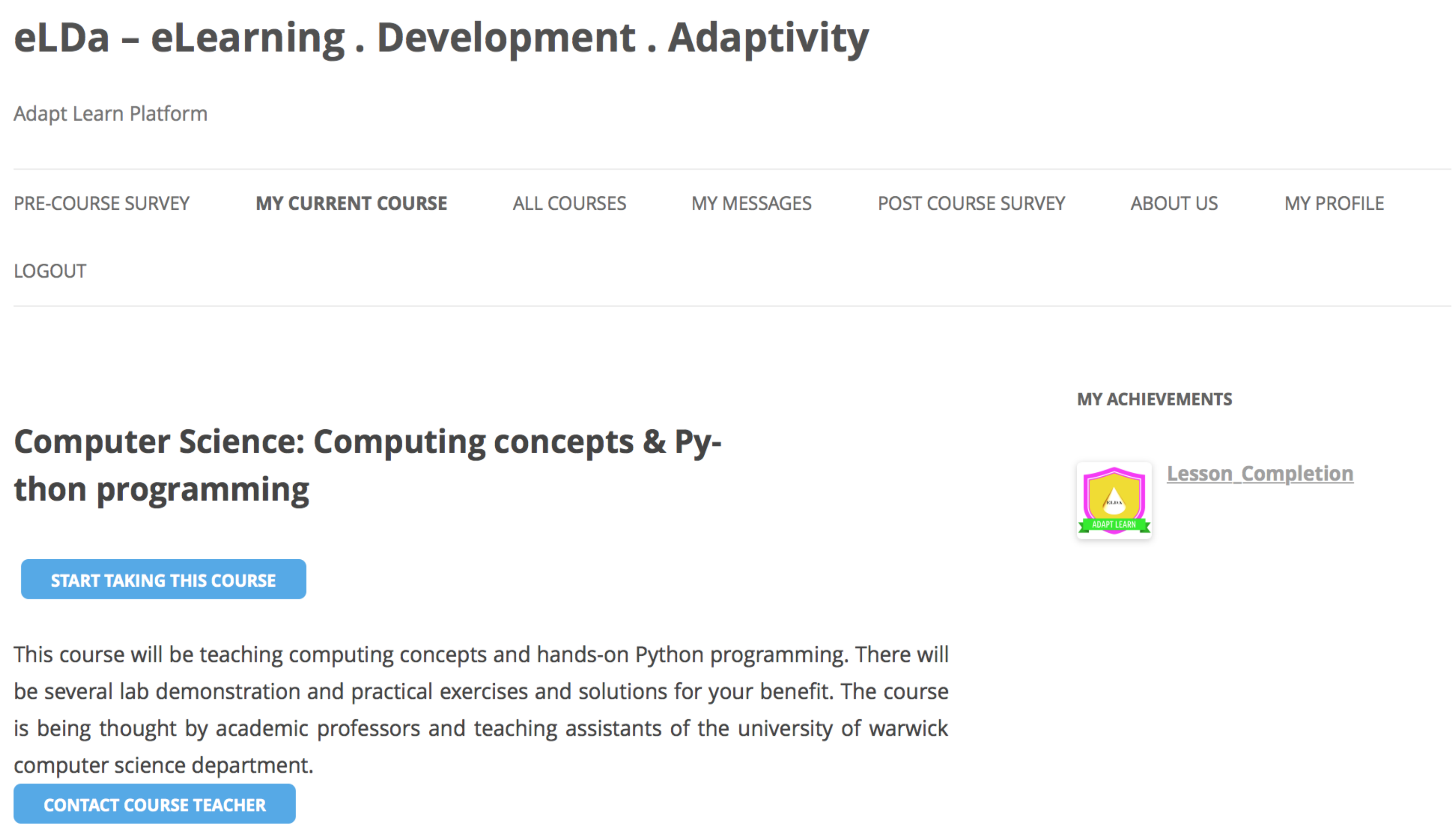

Figure 4.26: Course interface display.

4.4.19 Learning analytics and event log activities

Google Analytics was used to acquire knowledge of the events and logs of the users, the pages viewed, the time spent, the traffic location of the user, and the real-time user activities. At an early stage, Google Analytics revealed over 120 users from more than 10 countries, including the US, the UK, Malaysia, Russia, Nigeria, Switzerland, Germany, France, and Kenya, while there were only about 20 users in the database. Following this, we investigated and discovered that malicious users can hack the admin user name using the Internet Protocol (IP) addresses of the site domain to log in to the backend of the database to gain access to the course platform through the control panel (CPanel).

Web crawlers could also be counted as visiting the site, which might give inaccurate analytics of the exact users. Web crawlers are Internet bots that browse the web (World Wide Web) for the purposes of web indexing. This browsing task could be simple and repetitive. This led to a thorough investigation concerning the referral traffic and mode of accessing the course content. Thus, the research successfully created a defence mechanism to prevent these problems, as described in section 4.5. Figure 4.27 reviews the activities observed within the first few weeks of the course going live. Data analytics tools interpret the behaviour of the students by gathering the event logs and interactions within the course. Google Analytics and Wordfence plugins were incorporated to reveal and analyse the data based on the learner engagement with the course. Being able to understand the learning patterns of the students is a great step since it can raise the awareness of the instructor of the learning strengths and weaknesses of the students [239]. This provides valuable information about the learning resources to review to meet the learning preferences of the learner, which could be accommodated in course development.

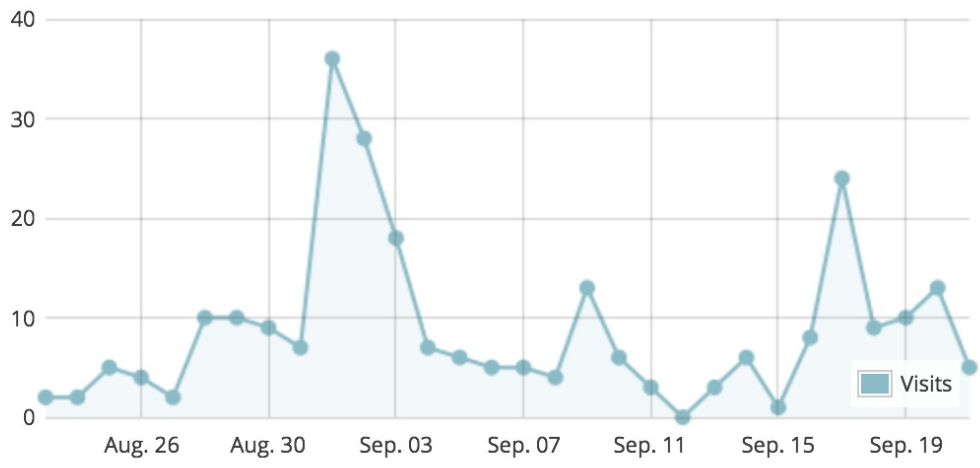

Figure 4.27: eLDa platform visit analytics.

Figure 4.28 shows real-time users (three learners live). This trial phase of the preliminary data represents our pilot study for the first two weeks of launching eLDa MOOC live on May 7, 2015. The learning analytics represent a continuous part of the research agenda.

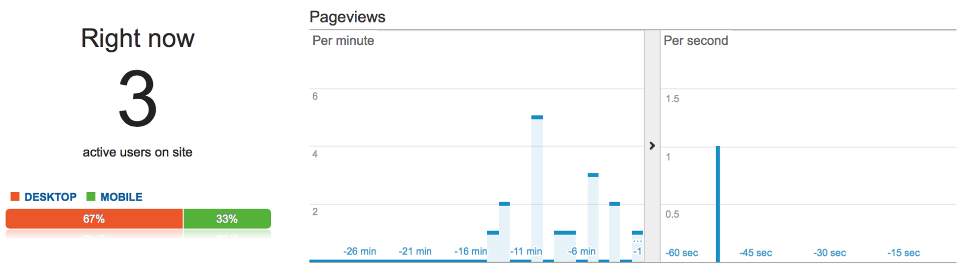

Figure 4.28: eLDa real-time course analytics.

Figure 4.29 illustrates the summary of activities, while Figure 4.30 shows the users' locations.

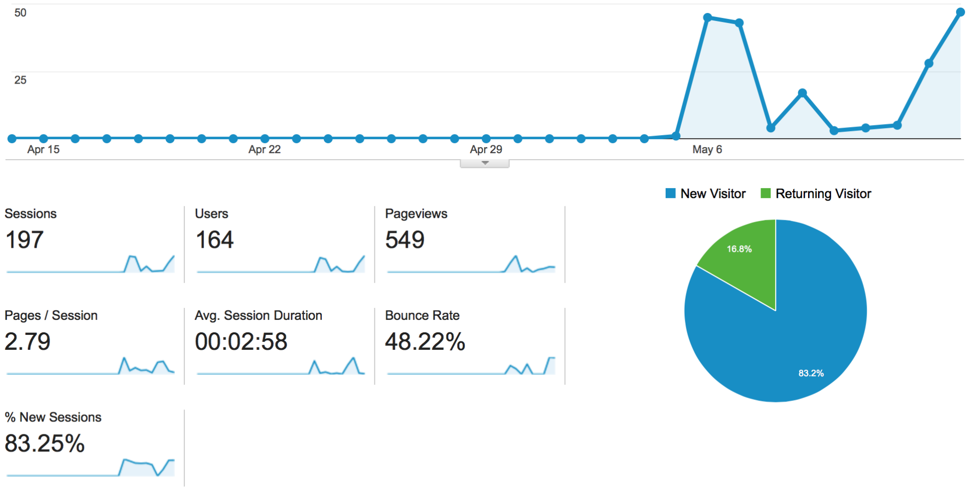

Figure 4.29: Summary of activities captured from learning analytics.

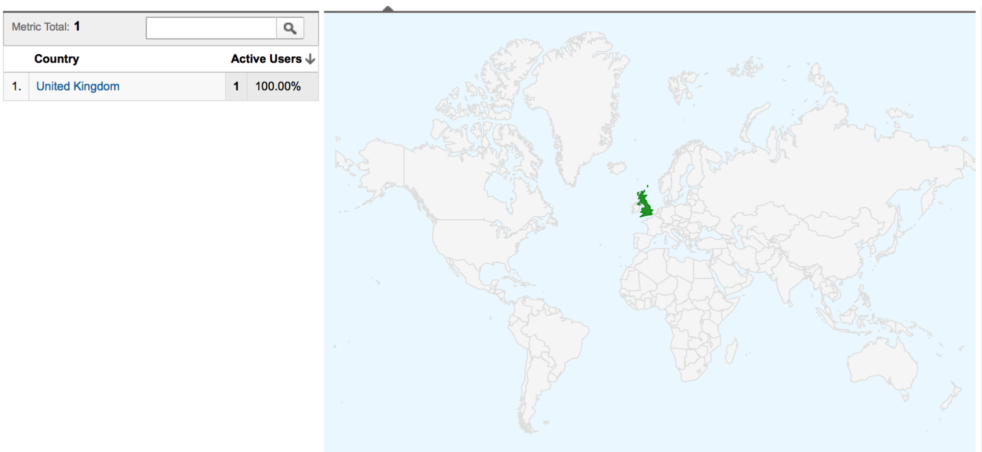

Figure 4.30: Learner's location captured on eLDa platform.

4.5 Security Issues

To make the platform free from intruders, web crawlers, and unwanted hackers, some security plugins to defend against these attacks were installed. Hackers and intruders used the default 'admin' user name and IP address to access the control panel (CPanel) to reach the backend database, enabling them to log in to the learning platform. This study used some plugins, such as 'limit login attempts', which restricts the number of times a user can log in to the platform. A user can try to log in three times; after the third time, the user is blocked from logging in for 20 minutes as illustrated in Figure 4.31.

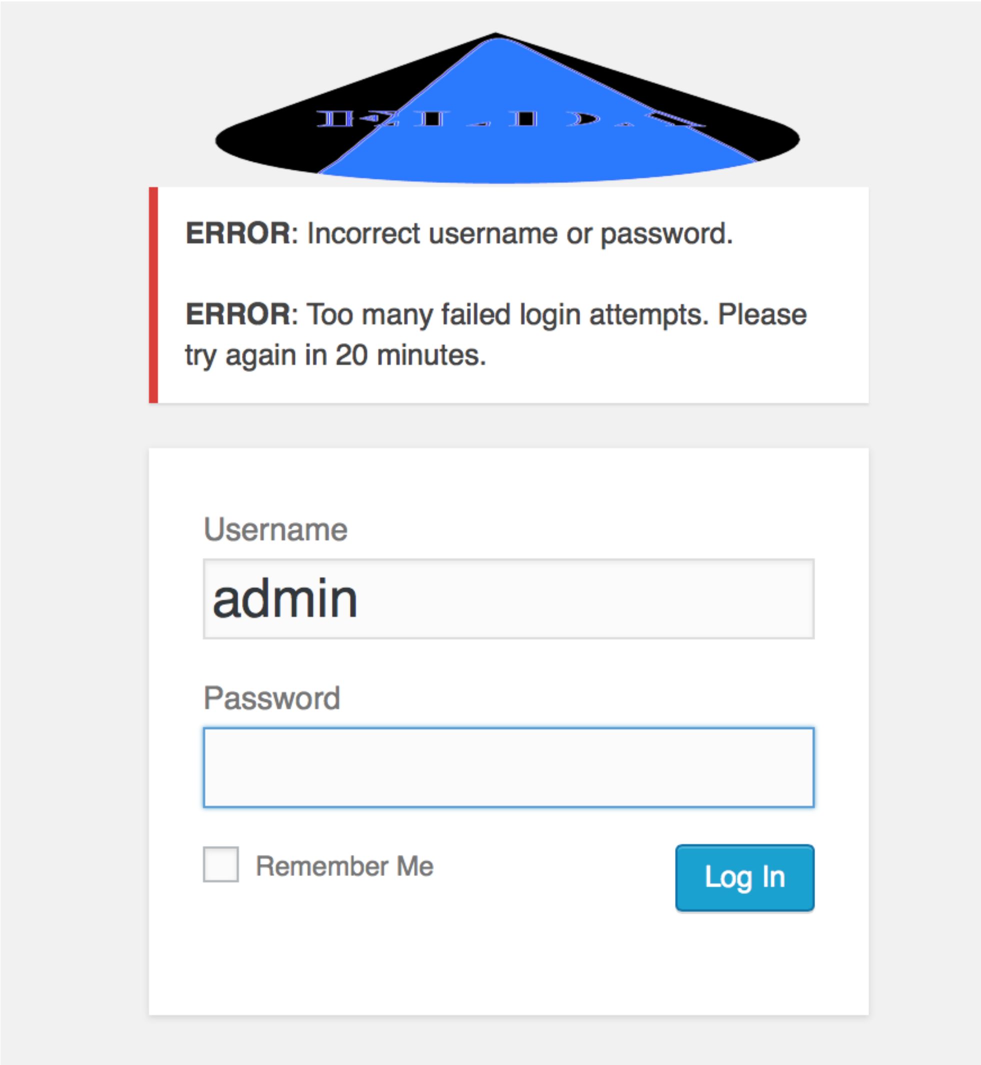

Figure 4.31: Visualisation of login failure.

In some extreme cases, such as in a repeated constant violation, the waiting period is 24 hours. However, if the users made contact by email, then the course instructor reset the password and informed the learner. Another plugin used was 'Wordfence', which prevents malicious software and hackers from gaining access to the course platform. Wordfence scans the eLDa learning platform for any threat and weak user passwords so that the administrator or instructor could request a password change from the user. There was a loophole in the design because of the default 'admin' user name used to create the course in the initial stage. However, the password was changed before publishing and migrating the course from the local host (the researcher's personal laptop) to the purchased domain and web-hosting services. This loophole has been resolved successfully as shown in the blocked and failed logins seen in Figure 4.32.

Top 5 IP's Blocked

IP	Country	Block Count
187.153.108.66	MX	1

Update Blocked IPs

Top 5 Countries Blocked

Country	Total IPs Blocked	Block Count
MX	1	1

Update Blocked Countries

Top 5 Failed Logins

Username	Login Attempts	Existing User
admin	32	No
onah	4	Yes
elaine	3	Yes

Update Login Security Options

Figure 4.32: The eLDa security and defence mechanisms.

Another way that security was strengthened was through the encryption of the user details, such as passwords and activation keys, as illustrated in Figures 4.33 and 4.34. As soon as the learner registered, the password was encrypted immediately with the security defence mechanism supported in the system. The activation code is sent to the learner from the platform, and as soon as the learner activates the code, the activation key is encrypted to protect the user details from security issues or threats. The login passwords and activation keys are encrypted and stored in the DBMS (in MySQL) of the platform.

user_pass
PB7vtosnh8i9Bp.8C11WvDTVFLe9eBK1
PB5l3.h/3L50c0f41Suxt9TvlAthZGQ/
PB.pVilQ5Mhq7rz/Gjq477TuQm/lpti/
PB14gRnqy0ACc8HNsbjzjZk7zVxB0Z5/
PBa4bRxZhBY2jjPkXfC7/UBmFfBByNM0

Figure 4.33: Visualisation of eLDa encrypted password mechanism.

registered	activated	active	activation_key
2015-10-01 20:36:44	2015-10-01 22:43:05	1	74158358e134667dd056bd39e82cdc16
2015-10-02 12:06:31	2015-10-02 12:59:07	1	3421039c7832261ed26528c2086dc3d5
2015-10-02 13:22:15	2015-10-04 17:02:06	1	8029a26c5258dcd204768045e60234a6
2015-10-04 07:33:59	2015-10-04 17:02:07	1	606b01d6cc64962bd934978e0ae88bba
2015-10-05 08:29:16	2015-10-05 10:09:32	1	19b63b607fcb5653d529550f5b7632a5

Figure 4.34: Visualisation of eLDa encrypted activation key mechanism.

4.5.1 eLDa mandatory access control system

In addition to the security defence system in the eLDa platform, a mandatory access control (MAC) mechanism to restrict or restrain unregistered users from gaining access to the learning platform was introduced. On the other hand, access is also restricted to registered users who try several times to log in using an incorrect detail (for example a wrong password). In this case, registered users are generally given discretionary access control (DAC) during their registration and login or it is created by the course instructor. The DAC can also be revoked by the system's MAC when suspicious activities are observed from the learner, for example, a learner trying to write a script to access the PHP files from the interface or attempting to access the dashboard of the platform and database. Figure 4.35 below illustrates the processes of the eLDa MAC on all unregistered users' login details, IP addresses, and so on, which are then blocked from accessing the learning platform.

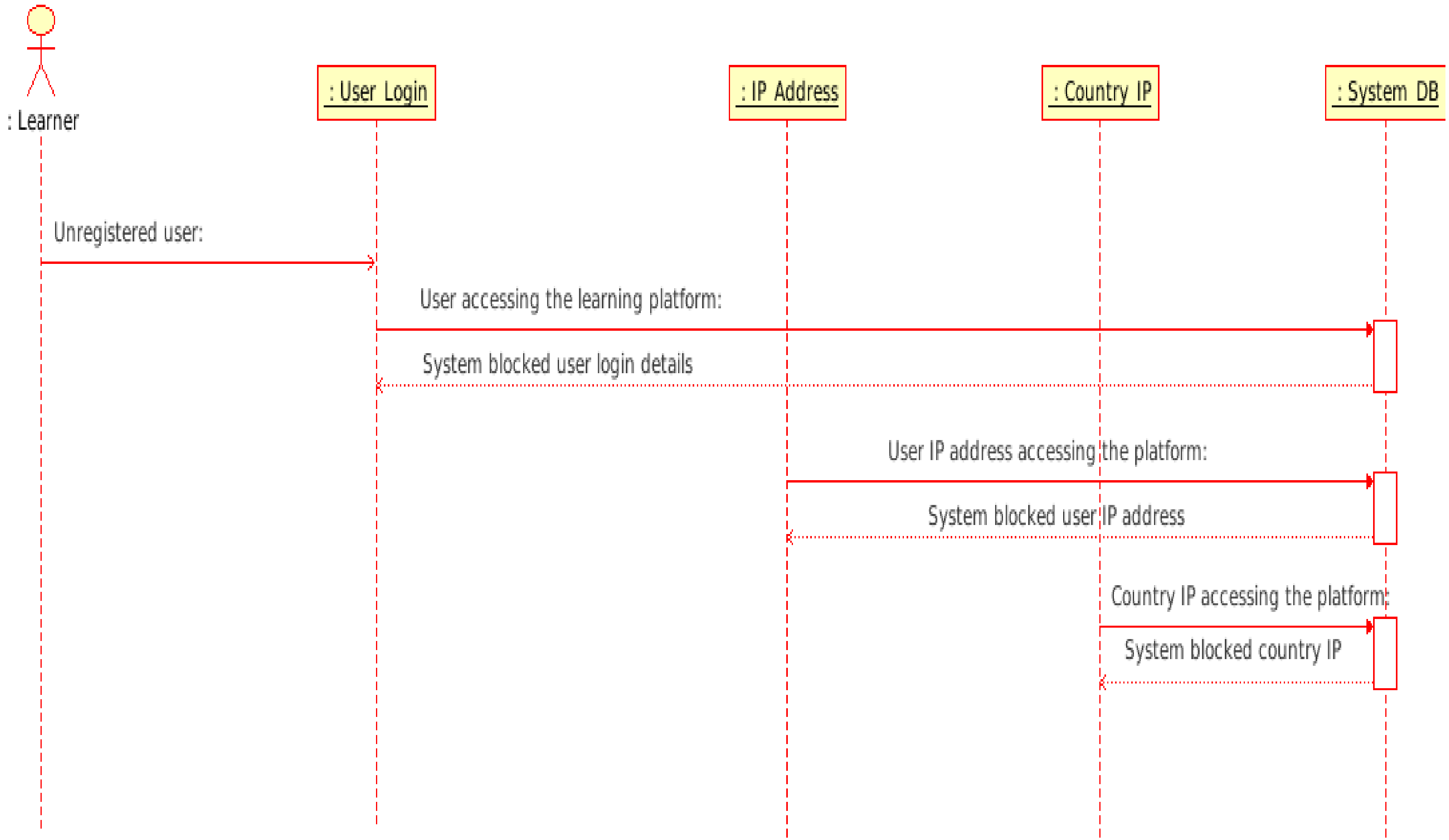

Figure 4.35: Diagram of the security access control process.

4.6 Significance of the Course Platform Design

The significance of this MOOC e-learning design was to enable course developers to consider good pedagogical principles in the design of their online courses and, especially, to incorporate adequate learner-oriented design goals. The study applied effective educational technology technique in developing an LMS that will deliver course content to the learners' needs. The platform tool used in this study allows learners to develop the freedom to direct their studies as they choose. The eLDa course platform is designed in such a way that, even with the standard lesson prerequisites, learners still have the autonomy to self-direct their learning paths within the course platform. The standalone course in the first case study serves as a way of educating teachers to improve their professional development in the aspects of computing and programming.

Developed by the investigation, eLDa is a novel MOOC platform that gives learners the option to decide on their path of study. Courses can be structured in a more traditional MOOC manner, with the learner following a predetermined instructional approach to accomplish the full learning objectives of the course. Alternatively, the platform provides the necessary support for learners to choose parts of the course without following a linear trajectory through staged sessions. The infrastructure needed to do this includes a mapping of prerequisites for different topics, a means for the user to determine their preparedness to attempt a topic, and visualisation for users to see which parts of the course they have completed. The learner is thus supported in self-direction of their study and can, if they choose, achieve greater autonomy in their learning.

Modern educational learning tools should be constructed to meet the required needs and expectations of the learners; thus, this could foster motivation and commitment [204]. It is arguable that modern technology with good pedagogical structure could play a significant role of helping learners achieving their learning outcomes [34]. The modern pedagogical design is an enhancement of existing learning design approaches. With the additional functionalities and the features or components determined by the learning platform, this could also direct the learners in making an informed choice of route during the learning process. Moreover, the basic principle is to describe how the various processes are common within all the underlying learning modes in the technology to function effectively to enhance learning experience [204, 33]. Learners decide on the route to study either in a self-directed mode or in an instructor-led mode. These different modes would not be possible without the incorporation of novel features and components to support the process in the learning platform. To support this for the MOOC to be presented as part of the blended approach, a novel platform (known as eLDa) was developed. This provided functionality to support learners' self-direction by means of features enabling an informed choice of prerequisites for different topics and visualisation of topics studied so far. Additional features, such as private messaging, allowed greater social interaction. Thus, in addition to supporting engagement with course topics and resources outside the face-to-face classroom sessions, the MOOC also gives students the opportunity not just to engage with course topics and resources at times of their own choosing but also to interact with each other and discuss course issues outside conventional class times.

4.7 Challenges of the Prototype

There were some challenges observed during the initial exploration of the choice of the existing prototype to support the proposed design tool for the research. A selected group of students in the university conducted the evaluation of the pilot study. During the first phase of the course going live online, there were several professionals in education who found it very difficult to register and login. This was largely due to the security defence system incorporated into the system design. The defence mechanism blocked and locked IP addresses that have attempted to access the platform several times. Therefore, this led to many emails and forum posts from computing at school (CAS) community members, the staff of the University of Warwick, and others from within and outside the United Kingdom. This issue was resolved, and email messages were sent to those affected after successfully clearing all the blocked users and locked IP addresses in the platform activating their login accounts.

Another issue concerning the registration failure was due to the plugin 'simple members only'; this plugin redirected all new members to the login page in a loop. The plugin was meant to allow only registered users to gain access to the eLDa platform. This issue was resolved by deactivating the plugin.

Another challenge was the technicality of the system. The development of the online learning system was achieved successfully over a period of three months with three consecutive failures. The failures came as a result of developing and creating new features with other plugins that were not compatible with the version and theme WordPress used. The design of the course development was started afresh thrice without initial proper back up. Thus, we purchased and used a portable 1 terabyte (1TB) My passport Ultra storage device designed by Western Digital to back-up the platform files to help secure the application, while preventing the reoccurrence of starting over again whenever there was a failure. All files were backed up and could be accessed at will.

There was an initial web-hosting problem and a need to set up the database to meet the web-hosting company specifications. The online course system used GoDaddy as the web-hosting company. At the initial purchase of the domain name, there was an issue with the database synchronisation within the control panel (CPanel) during the hosting. This was due to the migration technique that was used to migrate the course platform from the localhost: `http://localhost:8888/Adapt_Learning_Site/` to the new domain name: `http://eldamooc.org/`. This issue on migration from the MAMP local server environment to a live online system took about two to three weeks to be addressed properly by the course platform developer (the researcher).

The design and customisation was also a big challenge. The system was built to address the various backgrounds of learners and their study habits and to be in accordance with existing online pedagogy. To develop this course to be user centric, a one-month pilot study was conducted to acquire feedback data from participants who were selected based on purposive and convenience sampling. Nevertheless, a major challenge in this course was the membership and continuity.

One of the most difficult moments in developing the course was how to recruit committed participants. Several advertisements were made for participants and indeed some registered. Nevertheless, another major issue was continuity on the part of the registered participants. This is where our research interest emanated from. We worried about consistency and how engaging with the course components would facilitate and support effective participation. Feedback and questionnaires were deemed to be better ways to understand the learners' thoughts and needs, although we wondered many times how many of the participants would devote their time to respond to the survey questions.

4.8 Summary

Following a literature review and analysis of the results from the previous (traditional) computing MOOC, the eLDa requirements were established, and the system was designed and implemented. The platform supported learners in making informed choices regarding the direction or routes they wished to follow to obtain maximum benefits from the learning process. One of the novelties of the design goal applied in the self-directed and instructor-led modes was supported with the lessons' prerequisites to helped foster SRL skills of the learners. An initial pilot discovered several problems that were addressed. The research then entered the phase of course delivery. It was offered as a 'real' course, with participants being made fully aware of its status and expressing a willingness to assist in completing the questionnaires. Over 50 active participants (mainly in-service teachers and students) who enrolled have participated so far.

This study provides a means for the initial solution to these issues. Research has shown that a student-centred approach in course design is 'consistently viewed as more sophisticated' as compared to an instructor-centred approach which is considered a necessary factor for the integration of learning technology in education [158, 122, 286]. Considering the learners' needs and developing an e-learning course according to learners' learning patterns could help inform the course instructor and developer regarding the motivational elements and components needed to ensure continuous participation in the course. There are positives even in the negative drawbacks mentioned in online systems such as MOOCs.

To investigate issues of SRL and SDL in MOOCs, a novel MOOC platform was developed, known as *eLDa*, in which courses can be offered in 'traditional MOOC' mode (that is, as a structured, linear progression created by the instructor), but there is also the option for learners to choose their own learning paths. Additional features needed to inform and support learners in setting their own goals and determining a personal learning path include clarifying the prerequisites for each unit (and supporting users in assessing their suitability) and assisting with navigation and visualisation of progress. This study reports on the design and development of the eLDa platform and presents preliminary results from its use in a pilot study and hosting a live MOOC. Data collected from participants allow us to determine preferences for different ways of learning and between externally-directed and self-directed study modes. Chapters 6 and 7 present the findings of the research from two case studies implemented for this investigation.

A pilot study was conducted of the platform to acquire data regarding the effectiveness of this novel platform. In Chapter 5, a discussion on the results of the pilot study is presented. This enabled the live version of this study to acquire first-hand information of the learners' most preferred learning mode and how the course was restructured based on the results from the feedback. The current study hopes to shed some light on some aspects in the conclusion, and believe this helps to fill in some gaps and open an avenue for further research directions to address the issues raised.

Chapter 5

Pilot Study

This chapter presents results from the trial experiment, which was conducted to obtain feedback on the suitability of the platform, the course, and the survey instruments used. It also presents an analysis of data collected from participants to inform improvement for the course regarding the main delivery and data collection exercise. The study was conducted on a single online course offering a curriculum consisting mainly of computing concepts and Python programming. The pilot study was intended to enable the acquisition of useful information with respect to the various needs of the participants to inform further design approaches that could support learning. Information gained from the pilot study informed the implementations used for the two case studies in this research.

5.1 Aims and Objectives

The pilot study of this research trialled the eLDa platform using the resources of the computing MOOC, thereby exposing the learning desires and format of studying as revealed from the survey analysis. This awareness contributed in developing a good learning pedagogy to enhance participants' experiences. Another aim was to acquire learners' knowledge and the kind of learning resources they are willing to utilise. One of the design goals was to use elements of support to guide learners in directing their learning choices. Hence, the pilot study survey instrument gathered information on individuals' learning preferences.

5.2 Methods

The study was conducted with a small number of selected participants. The majority of the participants were undergraduates, postgraduates, and graduates from

University of Warwick. These participants were selected based on a convenience sampling approach to help in this investigation. Two weeks into the course, a pre-entry survey was conducted with the 24 registered learners, but the analysis of the results focuses on eight fully completed responses from this study.

After registration, the learners were requested to complete an online pre-entry course survey. After completing the entry survey, the learners were free to participate in the pilot experiment as usual in an online course format and engage in activities. The learners' activities were captured and a record of events was stored in the backend database of the system. The system used learning analytics features embedded in the course to retrieve the captured learning activities that were stored in the event log. This helped to reveal students' engagement with different activities, observed as past events or in real time.

This visualisation provided useful information that increased the understanding of how well the learners engaged with the course content. Separate in-course survey questions were embedded in each of the seven modules (as seen in Appendix D), but the results reported in section 5.3 are derived mainly from the pre-course survey in Appendix B.

5.3 Results

This section investigates learners' engagement, learning preferences, and expectations as observed within a period of one month. The results from this pilot study contribute to a crystallised idea on the final design of the course architecture as presented in Chapter 4. Figure 5.1, shows the active users in the course at the following points: first day, a week, fortnight and a month.

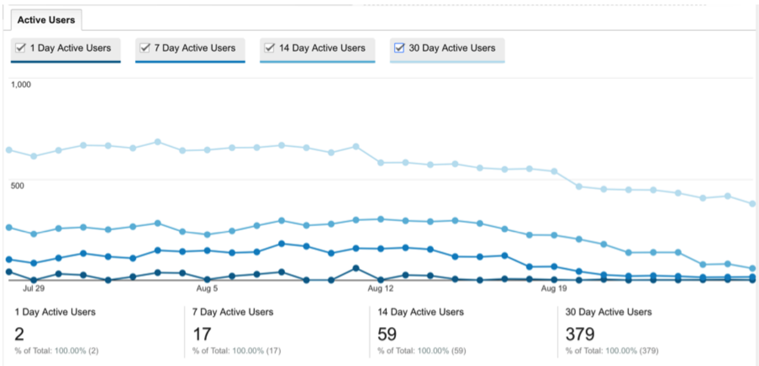

Figure 5.1: Active user report analysis.

5.3.1 Pre-entry survey results

The survey results show that about 62.5% (n = *5*) of the participants were male while the remaining 37.5% (n = *3*) were female (as seen in Figure 5.2).

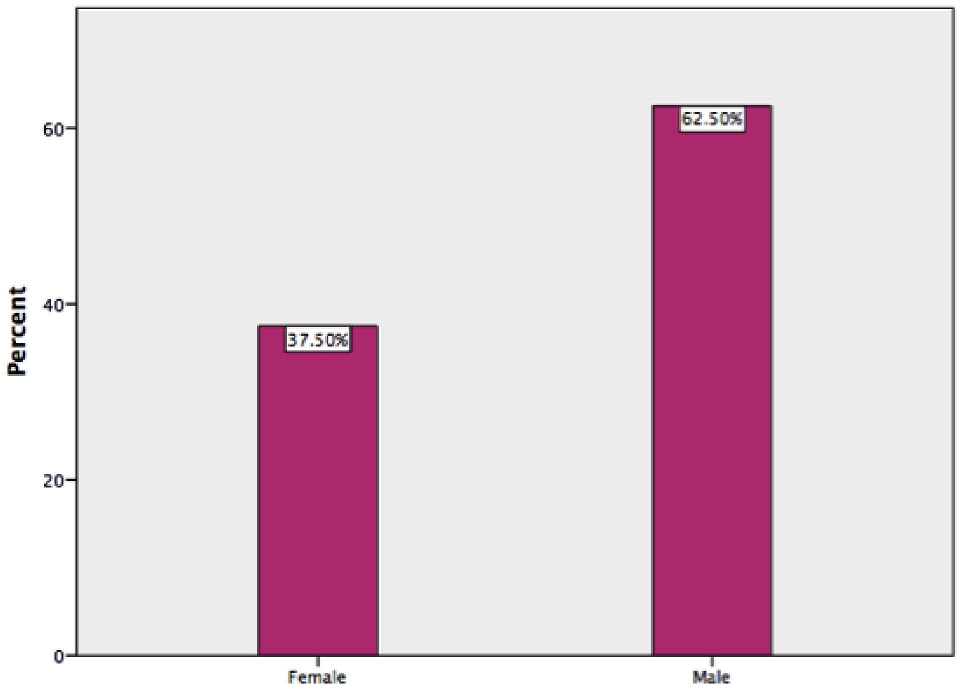

Figure 5.2: Gender demographics.

In terms of age demographics, the results show that the young generations within the age range of 25 to 34 years old comprises 37.5% and the second greatest age range is between of 35 and 44 years old, which is 25.0%, as shown in Figure 5.3.

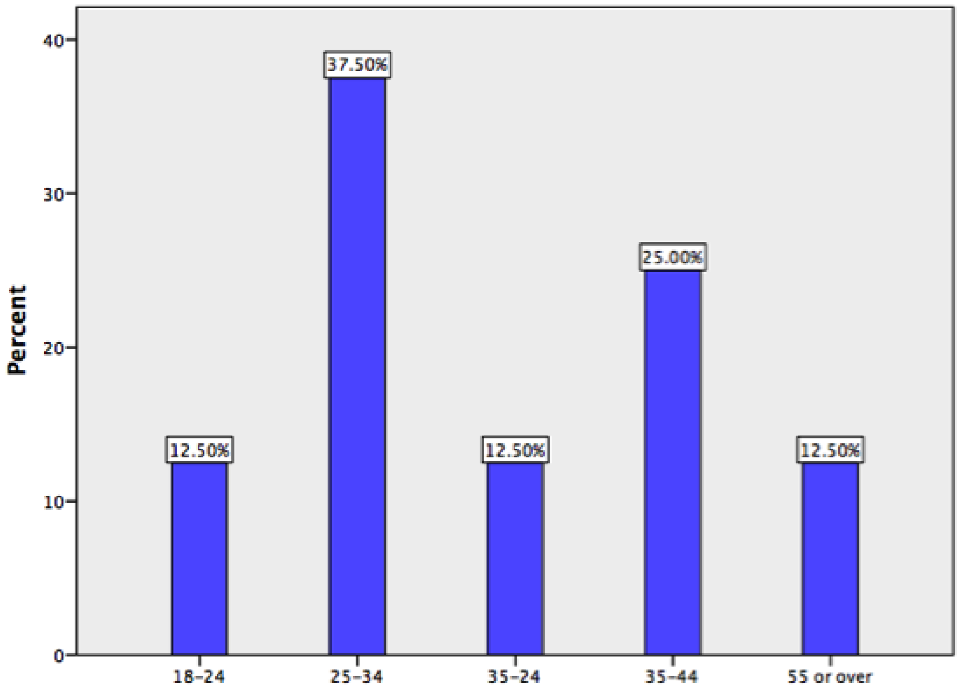

Figure 5.3: Age demographics.

When participants were asked if they had any experience with Python programming, it was observed that 62.5% indicated that they had some experience, while the remaining 37.5% of respondents said they had no experience in Python programming, as seen in Figure 5.4.

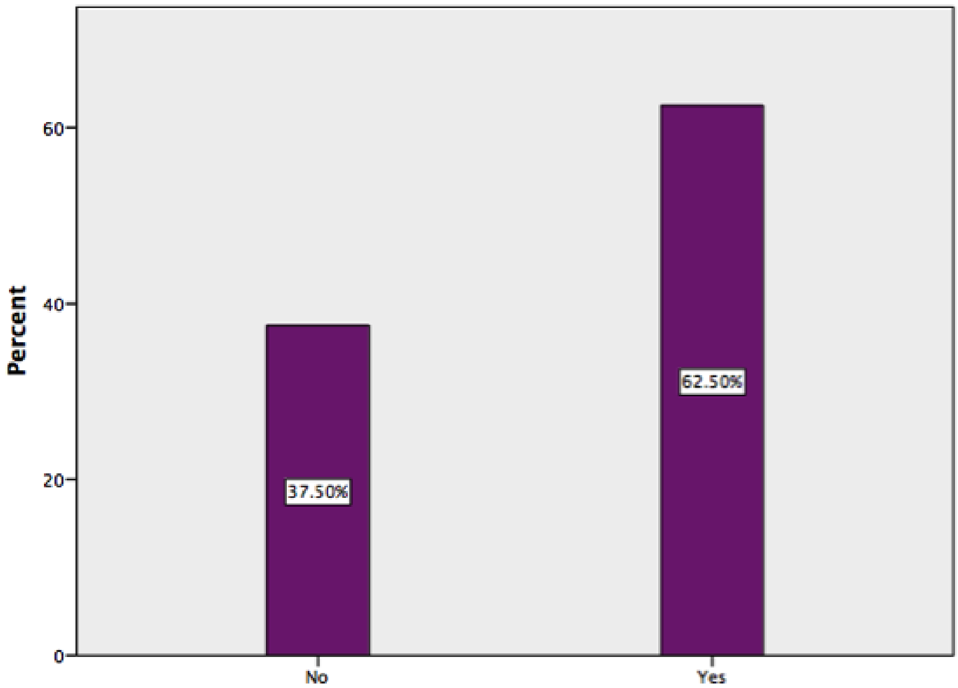

Figure 5.4: Python Programming experience.

The response to the survey question ‘have you had any experience in computing concepts?’, revealed that 87.5% said that they had experience in computing concepts, and 12.5% said they had no experience, as seen in Figure 5.5. The study anticipated this response because the course was developed with a purposive sampling population in mind, which was basically professionals and experienced teachers of computer science.

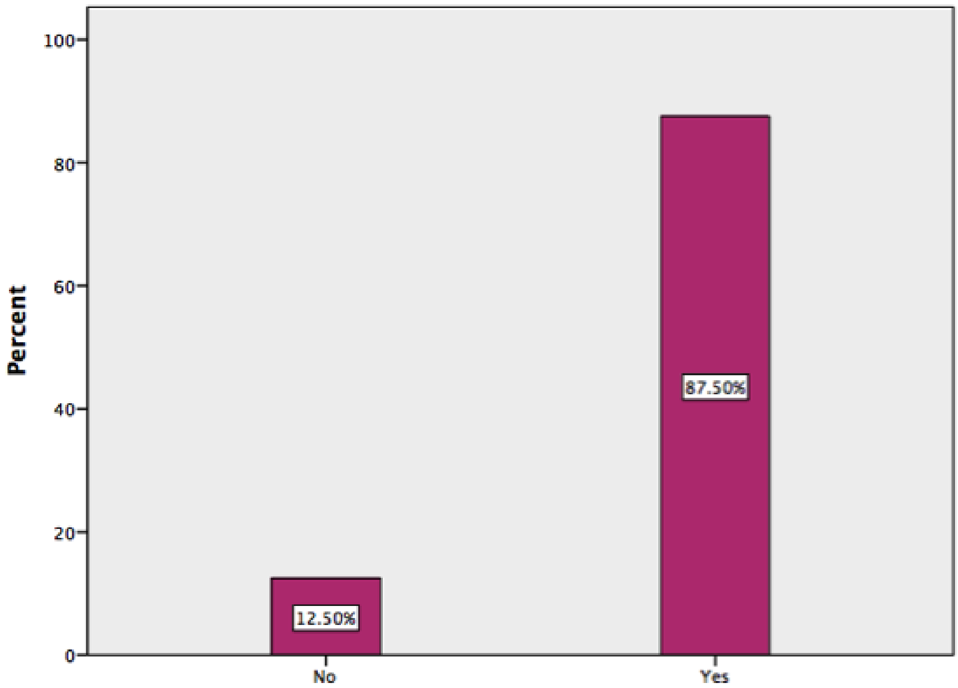

Figure 5.5: Computing concept experience.

There was a survey question on learners' expectations that shows that most respondents, about 23.33%, wanted to observe online education and a MOOC, while around 33.34% said they wanted to learn more about Python programming and learn new ideas, as seen in Figure 5.6.

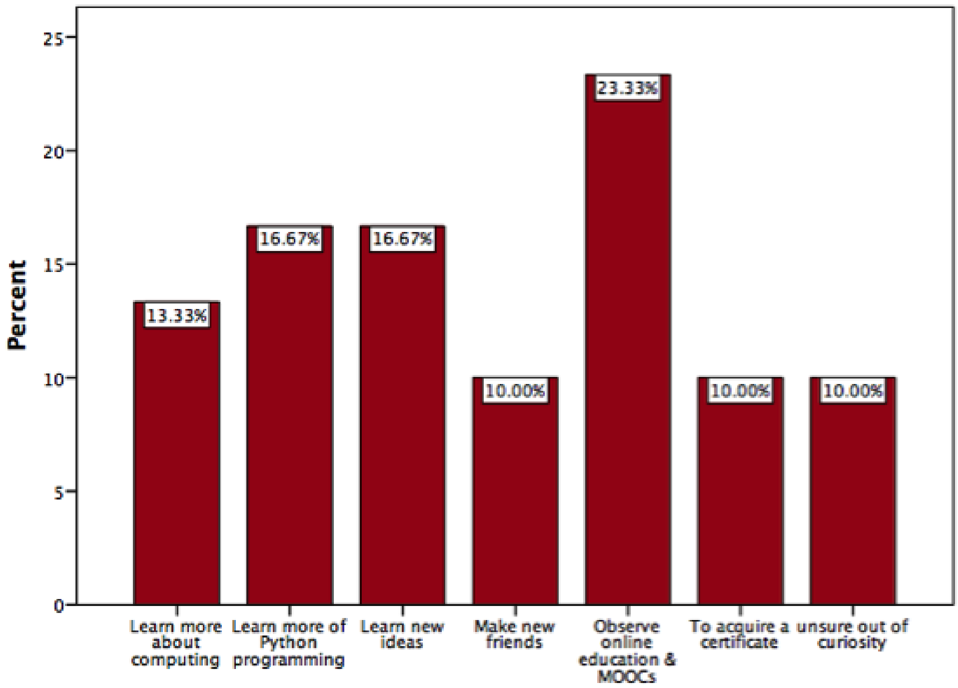

Figure 5.6: Learners' expectations.

In response to the survey question 'what motivates you to take this course?', 40% of the respondents indicated learning new skills, and 33.33% said 'out of curiosity', while 13.33% said to 'learn computing and programming' and 'interested in the course' each, respectively, as seen in Figure 5.7.

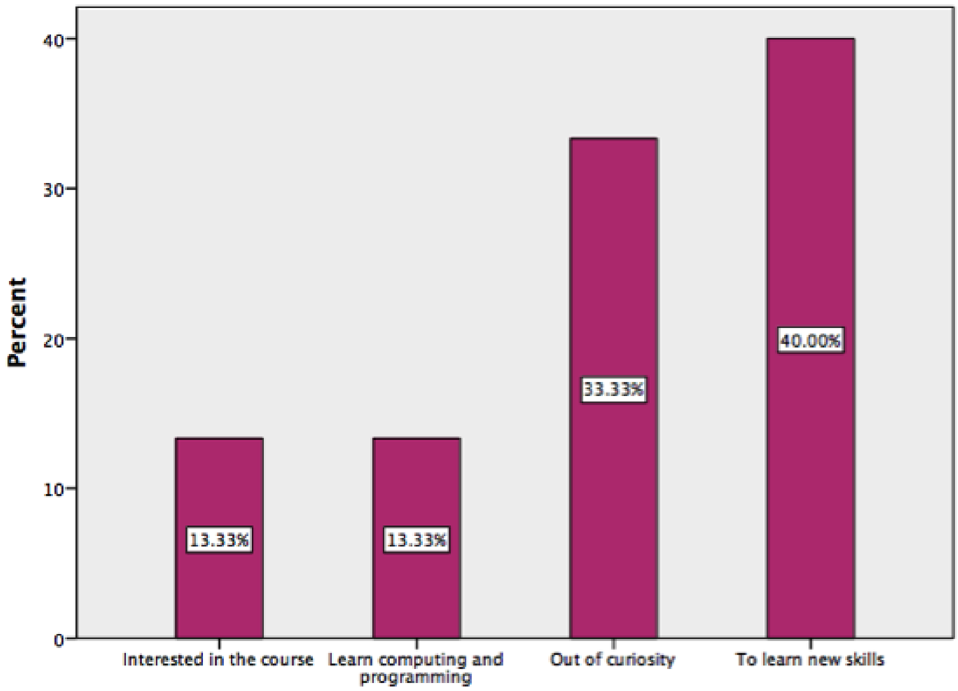

Figure 5.7: Learners' motivation.

Another survey question asked about the type of course most participants prefer, and the results show that 87.5% said they prefer short courses in a MOOC as compared to only a handful at 12.5% of respondents who said they prefer long courses (as seen in Figure 5.8). This shows that the majority of the respondents in the pilot study wished to engage appropriately in the course when the learning resources were delivered with short lecture videos and content.

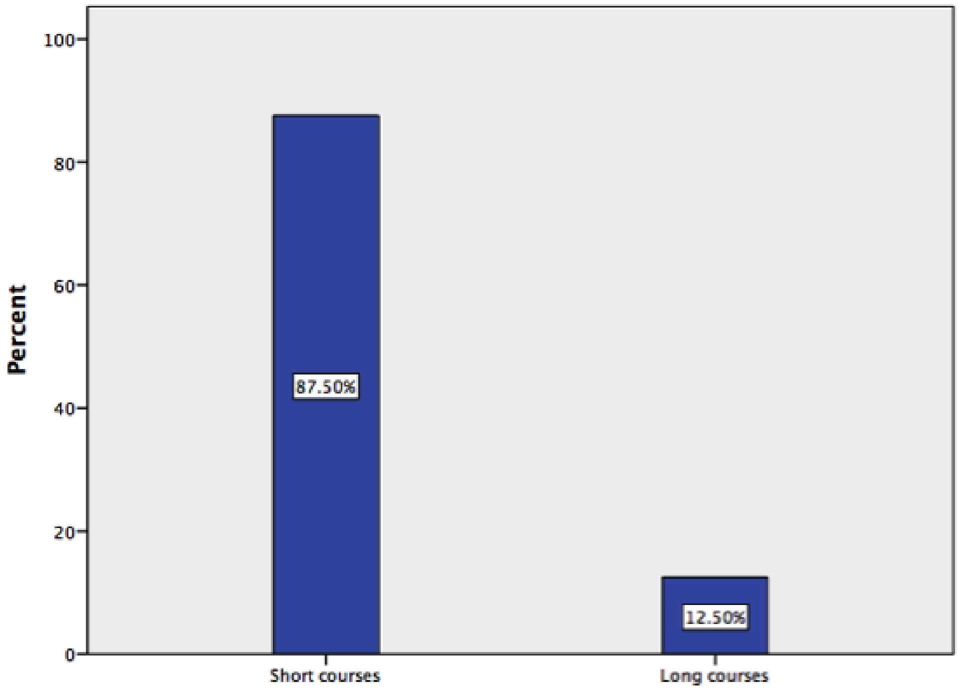

Figure 5.8: Course preference.

Since this was a pilot study, most of the participants heard about the course from the tutor and course developer. Figure 5.9 shows that 55.56% of respondents heard of this course from the course tutor and 22.22% of respondents heard about the course from both 'online resources' and 'word of mouth from friends' each, respectively.

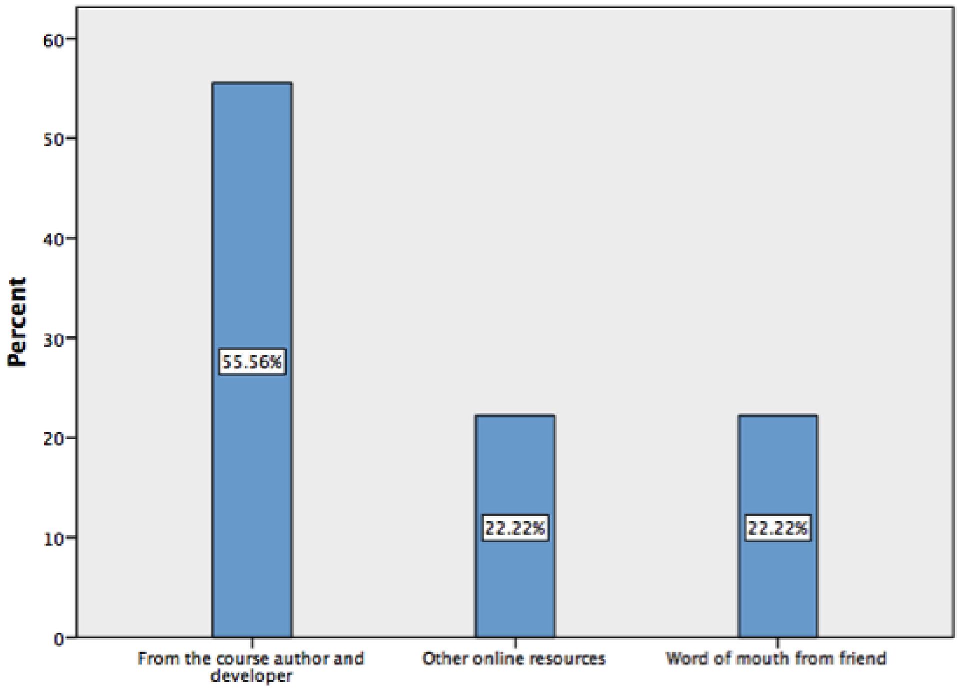

Figure 5.9: Course information.

In response to the question ‘how much of time do you intend to spend per day in the course?’, the result revealed that 62.5% would spend ‘less than an hour’ in the course, as seen in Figure 5.10.

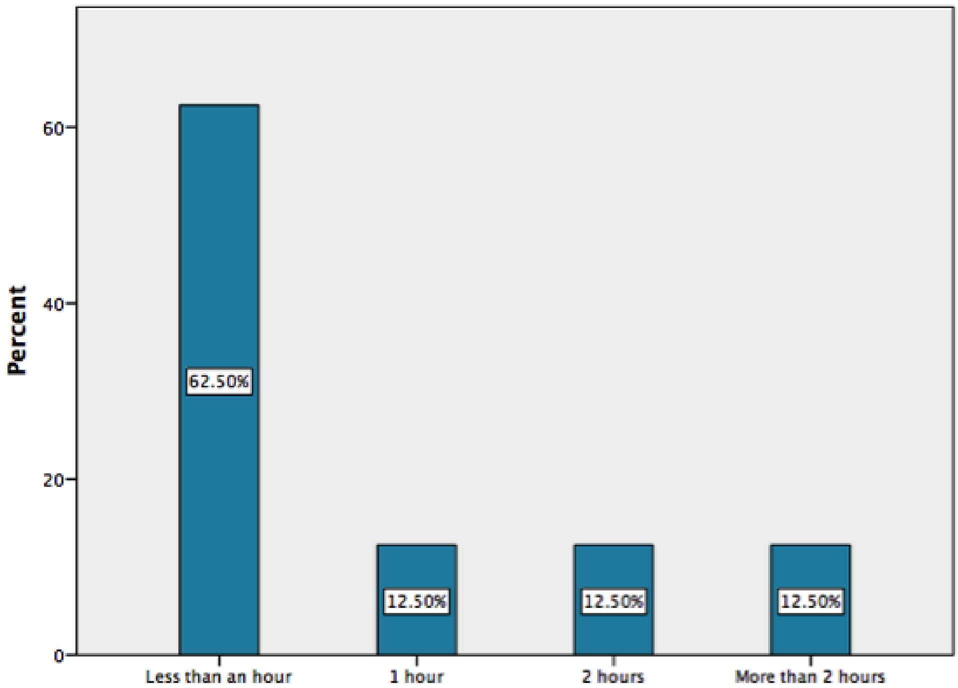

Figure 5.10: Intended time per day in the course.

In a similar question to the previous one about the duration in terms of days, weeks, and months on participating in the course, the result revealed that 50% of respondents said they would spend more than five days, while 25% of respondents said they would spend more than two weeks when asked how long they intended to spend on this course, as seen in Figure 5.11.

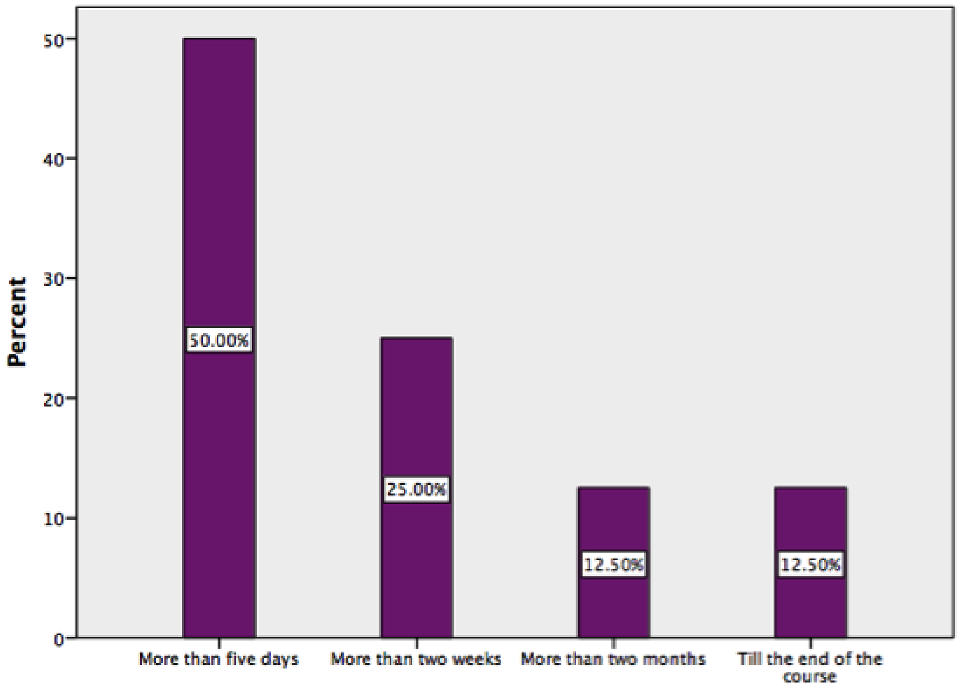

Figure 5.11: Scheduled period to spend on the course.

In response to the survey question, 'do you prefer short courses to long courses?', the results show that 75% prefer short courses to long ones, and 25% prefer long courses, as discussed earlier. This also revealed that the participants in this pilot study were mostly interested in short online courses, as discussed earlier (seen in Figure 5.12).

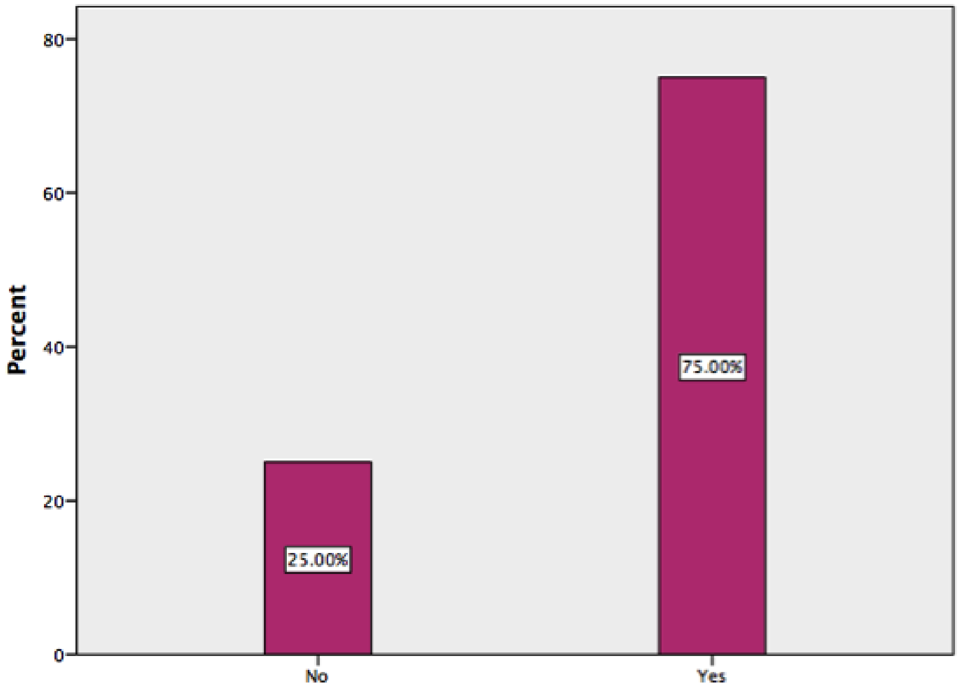

Figure 5.12: Course type preference.

When the learners were asked 'Do you prefer watching short lecture videos to long lecture videos?', the survey result showed that 87.5% of respondents prefer watching short lecture videos compared to 12.5% of respondents who prefer long lecture videos, as seen in Figure 5.13. This shows that learners in this study are more inclined and encouraged to watch more videos if they have short delivery time and become discouraged if the observed lecture videos are too long.

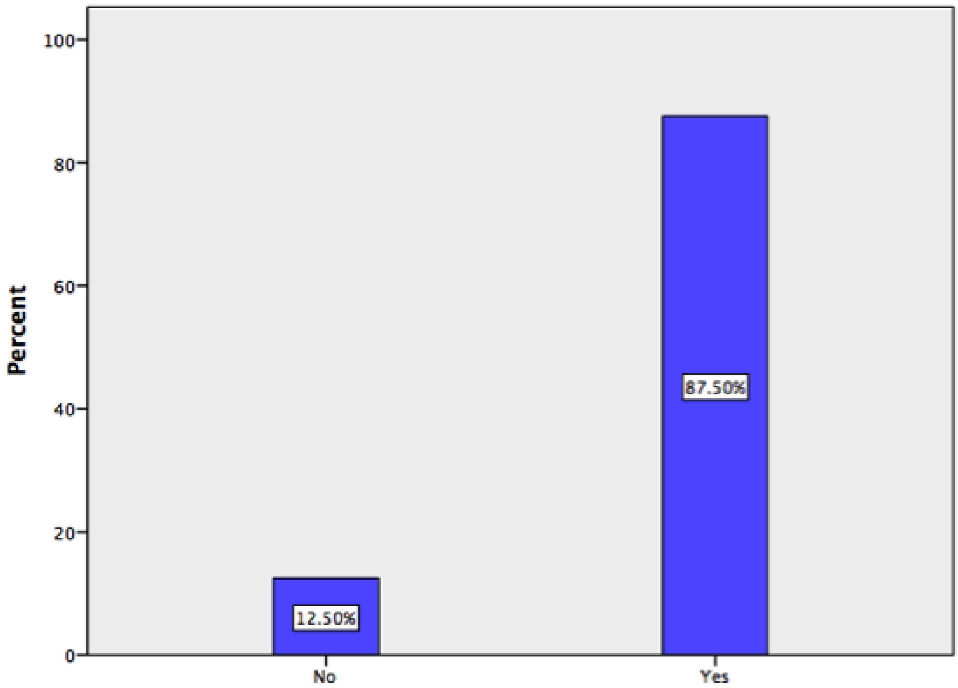

Figure 5.13: Course video types preferred.

The final pre-entry survey question was 'what kind of online course delivery do you prefer?'; this reveals that about 46.15% of respondents prefer interactive learning and 23.08% prefer self-mode learning, as seen in Figure 5.14.

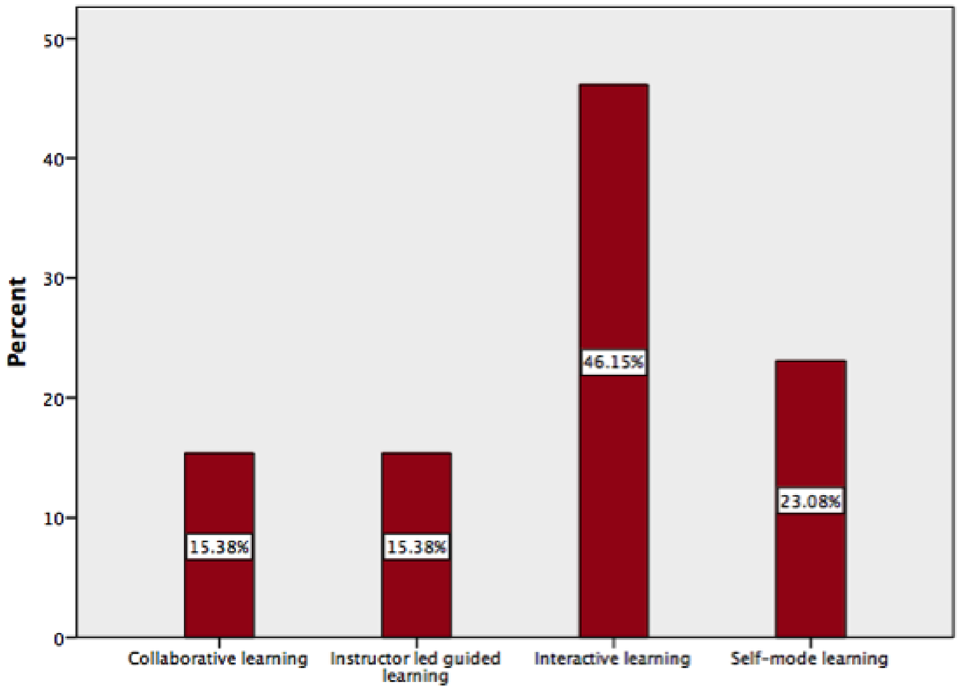

Figure 5.14: Online course delivery preference.

5.4 Implications of the Pilot Study

The responses from the pilot survey provided information on aspects such as learners' expectations, preferred approach to online learning, and so on. This helped in constructing the live course and surveys. In terms of the course content and duration of delivery, some of the questions with regard to the duration spent in the course enabled us to provide content with shorter videos, lessons, and modules. With knowledge of the preferred kind of online course delivery, we were able to meet these learners' needs by providing interactive components, visualised course content and instructional methods in the eLDa platform.

The initial visualisation of the content did not provide much evidence with respect to learners' engagement and perceptions of the course. This led to the visualisation of the level of progress, that informed the learner of the lessons completed, and the next lesson to study. Table 5.1 presents selected shortcomings revealed by the pilot study, and improvements made before the launch of the live course.

Table 5.1: Improvements to the research design.

Shortcoming (Pilot Study)	**Improvement (Live Course)**
Difficulty of getting participants to complete the online survey questions used in the study.	Embedded email system was introduced in the improved design to enable sending frequent reminder messages to complete the survey. Notification messages were displayed on the course interface to emphasis the completion of the survey questions.
There was insufficient communication channel in the pilot study to support peer-to-peer and tutor interaction.	There was a need for incorporating private messaging functionality to support effective communication among all the participants and the tutor.
Learners' activities were not fully tracked due to the lack of effective visualisation of their progress.	A further refinement of the learning analytics tracking system was incorporated to store learners' activities in the event log data for further evaluation.

Two major implications arose from the pilot study: (1) the need to implement further functionality to support learners' choices in SDL; and (2) the application of the methodology to a blended-learning context. Another vital implication is that these survey questions probe perceptions on how learners generally use the MOOC technologies while studying. The improvement of the system enabled us to collect useful data from the MOSLQ from learners interacting with the course either independently or being guided in an instructional manner. The basic evaluation and analysis of the pilot results helped us to reflect on a more appropriate manner to present the results from the main studies. This led to the modification and introduction of new methodologies that were used for the data collection and analysis of the results in the final case studies.

As a pilot study, this data collection exercise collected responses from just a small group of students and for only a limited trial period of two weeks. However, this was sufficient to indicate problems with obtaining responses and general areas for improvement which were addressed as outlined above.

5.5 Platform Issues Arising from the Pilot Study

The pilot study also helped in refining the eLDa design in order to diagnose problematic issues with regards to learner access. The platform was further enhanced by incorporation of the Wordfence security plugin. This answered a number of security concerns, for example, by providing the ability to identify and block potential inappropriate behaviour from unregistered users. There were some issues at the early stage of the trial. Participants found it difficult to log in with the account created. This issue was as a result of a plugin used in the design. The plugin blocked everyone trying to log in more than twice. The passwords were protected and case sensitive, and if the wrong details were used to log in, access was denied. The system logs showed the blocked users and their IP addresses. This security feature was established for intruders, not to prevent authentic learners. To solve the problem, the design was updated to incorporate a mechanism to allow genuine registered learners to gain access and request a password change. New functionality was also added to send learners a registered password at registration, so they could use it for all subsequent log-ins.

The pilot course lacked complete visualisation of lessons covered. To provide learners with a knowledge map of topics studied, the updated system incorporated a progress bar functionality to point learners to lessons completed and those yet to be studied.

There was a need for effective interactivity in the learning tool. Some users could communicate with the tutor about issues encountered because they had the instructor's personal email. Others, however, had to use a public community forum where the course was advertised to discuss, for example, their login issues. This informed the inclusion of standard discussion forums and community channels, which were developed to help learners communicate with each other and the tutor. Several learners joined the community forum and shared their experiences about the course. Some learners used the channel to clarify issues on a module and ask questions regarding any concerns.

In the pilot study, a lack of learner engagement was observed with the other built-in features, such as the quizzes. There was very little participation with the in-course comment boxes and in-course surveys that were incorporated in each of the modules. The study also observed low participation in the areas of in-course exercises and on Python programming practice. A desire to encourage greater participation informed the development of a notification mechanism to alert learners when new exercises and quizzes were deployed in the blended-learning course.

5.6 Improvement on the eLDa Platform as a Result of the Pilot Study

This section presents some of the improvements made on the course after the implementation of the pilot study.

5.6.1 Platform

In the eLDa platform, some features are different from the existing MOOC systems, for instance, the introduction of instant messaging contact with the course instructor for support and assistance. Another feature was the incentives to encourage and motivate more consistent participation. For example, some platforms only provide digital badges as an incentive after certain activities have been completed. In contrast, digital badges were presented to all registered participants in this study. The eLDa design involved two main components that were enhanced. The first component gives the learner the ability to study at a self-directed pace, having the freedom to learn as they desire. The second component guides the learners in an instructional manner to acquire full understanding of the course content.

5.6.2 Course

This study conducted a pre-entry survey to obtain the initial understanding of the learners, their preferences in an online course, and how they react to the features and concepts introduced in the course platform. Another interesting feature that was amended in the final version was the modification of the enforced prerequisites in the course. The suggestion and feedback received from some participants informed the changes. The learners had the freedom to completely direct their studies while the instructor-led mode of the course was directed. The blended-learning mode was structured using short content delivery due to the response received from the pilot study that shows most of the students prefer or are predicted to engage more with short lecture content and videos as compared to long ones.

5.6.3 Survey

This pilot study reveals some results from the pre-course entry survey, which shows the demographics, expectations, and aspirations of the learners in the novel eLDa platform. The results explain the aspirations of the participants and their chosen mode of participating in the course regarding the type of instructional course content they prefer. The study shows how learners are willing to interact in forums to be supported in their studies. The survey further explores the perspectives of the participants and their experiences during the course in this new structure.

5.6.4 Communication

Information dissemination was vital for this new learning platform to recruit participants. The pilot study lacked the complete channel of communication from students to students and students to tutor. This informed the incorporation of discussion and communication features, such as the private messaging system that enabled effective communication from tutor, and learners to tutor and learners to learners. The course awareness was communicated to friends by the students within the university and further advertisements were done via blogs, community forums, and so on. This led to a drastic change in participants demographics as the course went live and series of requests to participate were coming in by the hour.

Figure 5.15 presents features updated on the live course as a result of the pilot study.

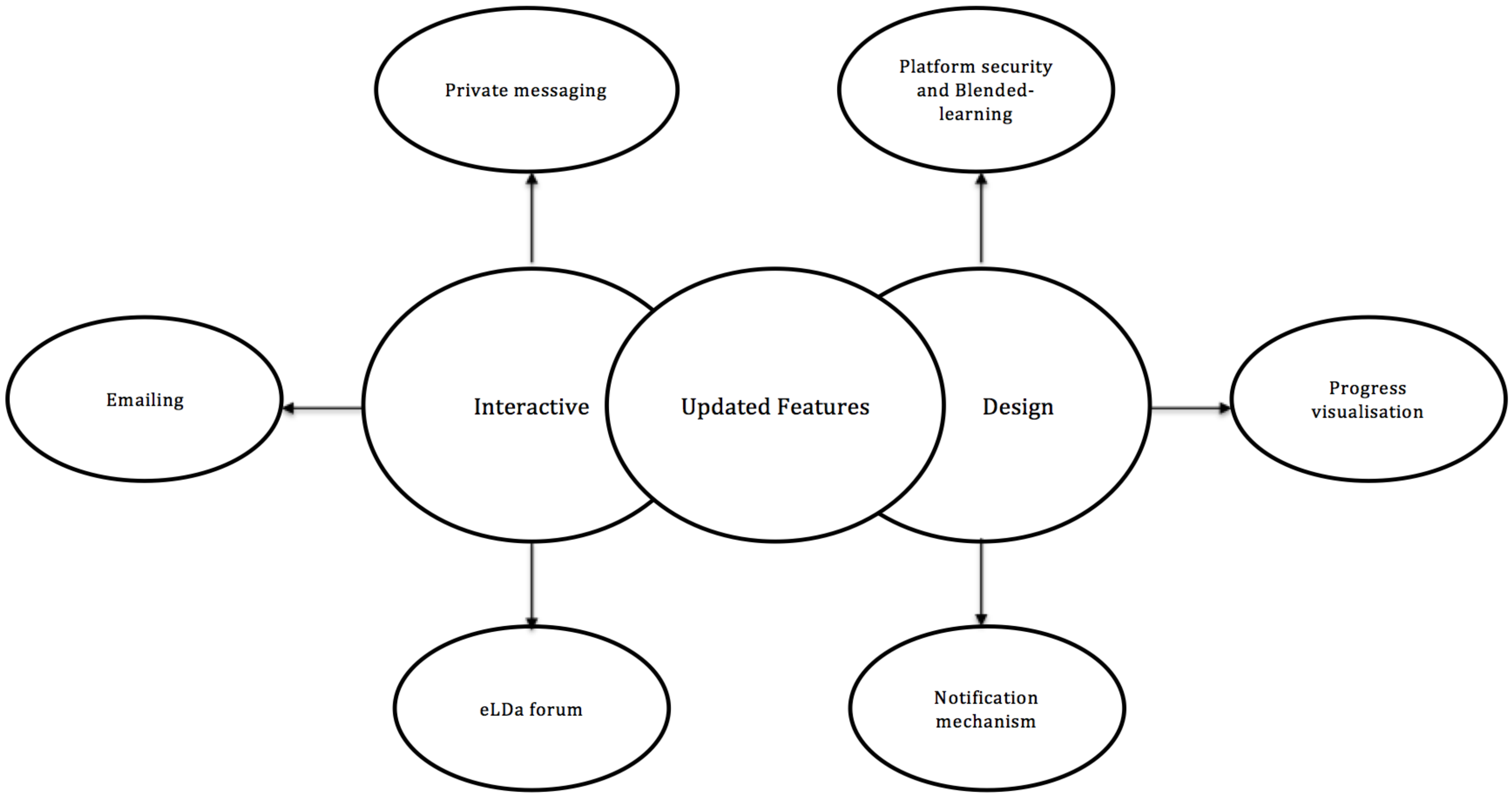

Figure 5.15: Features updated in the live course.

5.7 Summary

The pilot study suggested useful refinements which could be made to the research tool. Similarly, it provided valuable feedback which supported improvements to aspects of course deployment and support. In addition, it allowed the survey instruments to be trialled and any ambiguity or lack of clarity to be rectified. This pilot study also helped to explore learners' perceptions of the course platform. The results of the pilot study were used to inform the further development of the questionnaire items used in the final case studies. The findings from the pilot study survey also supported refinement of the methodologies and data collection processes that were finalized for use in the main case studies, have helped in increasing the sample size. In particular, the feedback received from the study enabled better wording and structuring of the SRL questionnaire used in the case studies.

Improvements to the MOOC platform and to the MOOC itself that arose from the pilot study were incorporated in the design and implementation of the system through a further round of development. This resulted in an improved platform which was more robust and better able to support an effective learning experience. The version of the platform emerging from this round of development was taken forward for use in the main case studies. Similarly, the course that was implemented for the pilot study was improved following the pilot evaluation and became the course used in the first case study. That is, it progressed to live launch and was used to investigate the use of MOOCs in standalone, online mode. The details of this case study and its results are given in Chapter 6. A second case study, in which a similar investigation is conducted for an eLDa MOOC used in the context of blended-learning, is presented in Chapter 7.

Chapter 6

Case Study I : Online Course

This chapter reports results from the first case study relating to MOOC use for fully online learning. The following research questions were addressed.

RQ2. What patterns of learner activity and resource usage are observed within a MOOC that support learners' choices of different learning routes?

RQ2.1. *To what extent do learners choose to direct their own study path as opposed to following a guided course?*

RQ3. Does a learner's capacity for self-regulated study relate to the choice of learning paths and the ability to succeed in a MOOC?

RQ6. What are the implications for MOOC pedagogy to foster SRL?

Section 6.1 discusses 1) the overarching research methodology on a general level, 2) why the used approaches were chosen, and 3) the questions addressed using these research methods. It also presents the research methods, data collection approach, and analysis of methods. Section 6.2 presents the research participants, results, and findings in more detail. Section 6.3 addresses the measuring instruments used for the study and presents some detailed results. Section 6.4 describes the discussion concerning the research in detail, and finally, Section 6.5 concludes the chapter and describes the implications of the study.

6.1 Methods

This case study investigates issues of SRL and autonomy in the context of a MOOC deployed for fully online learning. This section sets out the objectives of the work and the approach used to investigate the research questions. As described in Chapter 3, section 3.3, a DSRM was used as the overarching approach in this section. The approach is often incremental, with an artefact undergoing successive rounds of development, evaluation, and feedback of the results into the next iteration. In the present case, the eLDa MOOC platform (described in Chapter 4 and specifically in subsection 4.4.4) was developed with the first-stage objectives of (a) supporting two modes of engagement (self-directed and instructor-led) and (b) collecting user data on SRL skills, learner preferences and chosen learning paths.

In the first case study, the platform was used for the development and delivery of a computing MOOC. The MOOC presents computing concepts and provides grounding in Python programming, reusing materials from a previous course, which had been run several times in the 'traditional' MOOC mode with over 900 participants in total [283]. In addition to the novel features relating to self-regulation, the course for this case study was designed to incorporate several acknowledged 'best practice' approaches associated with promoting active learning and maintaining motivation in the MOOC context.

A total of 107 participants were recruited for the trial run of the course by advertising the course via social networks, colleagues, the CAS network, and the local university community. Since this was being run as a live course, the need to provide a high-quality learning experience was paramount and had to be balanced with the research needs of the exercise. A figure of around 100 participants was deemed to be a group size for which the study could provide effective learning support in this initial delivery of the course. The course was conducted over a period of seven months from mid-May 2015 to the end of December 2015. In advance of the data collection activity, appropriate ethical approval was sought and obtained from the university's research ethics committee considering the 'ethical principles' as described in Chapter 3.

6.1.1 Methods of data collection and analysis

Data collection was by means of a start-of-course survey administered to all course participants. As well as the more usual demographic and satisfaction information gathered by MOOCs (about the user, their aspirations, their experiences of the course, and so on), an SRL survey was included along with questions relating to participants' preferences for mode of study. The SRL survey was based on the OSLQ survey discussed in Chapter 2 and specifically in subsection 2.8.7, which is an established SRL instrument previously validated by its developers [29]. Our version included slight modifications to ensure the suitability to the MOOC context. The modified version of the instrument applied to this study is referred to as the MOOC OSLQ (MOSLQ). The instrument uses Likert-scale response questions covering the six SRL dimensions: goal setting, task strategies, time management, environment structuring, help seeking, and self-evaluation. The full survey is presented in section 6.3.

General course surveys were administered to all participants. However, to avoid interfering with the participants' learning experiences, cooperation with completing the more detailed SRL surveys was sought on an optional basis. The responses to this were from a subset of the overall cohort. The quantitative data collected in the course were exported to SPSS, and the SRL results were analysed to obtain cohort statistics and learner profiles using a variety of appropriate statistical tests.

6.2 Results

This section reports the initial results from data collected at the start of the course relating to participants' demographics, their aspirations, and their SRL skill levels.

6.2.1 Participant demographics

Of the 107 registered participants, 59.3% were male, and 40.7% were female. Over a third (37.0%) were in the age range of 35-44 and just over a quarter (25.9%) were between 25 and 34 years old (Figure 6.1). In this course, less than 20% of the participants were aged 45 years old or over.

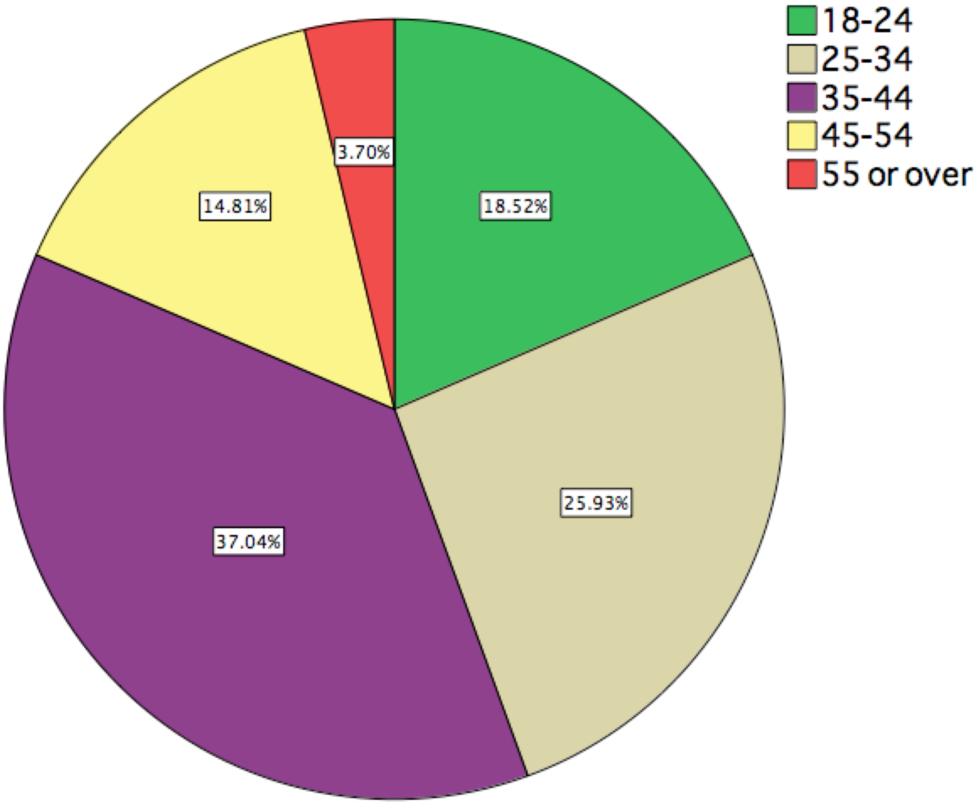

Figure 6.1: Age of MOOC participants (n=*107*).

In line with previous research, our data indicate that most participants (over 70%) were either graduates or current undergraduates (as illustrated in Figure 6.2). Thus, most had existing experience of formal learning at the graduate level. It might therefore be expected that, in general, levels of SRL skills would be high.

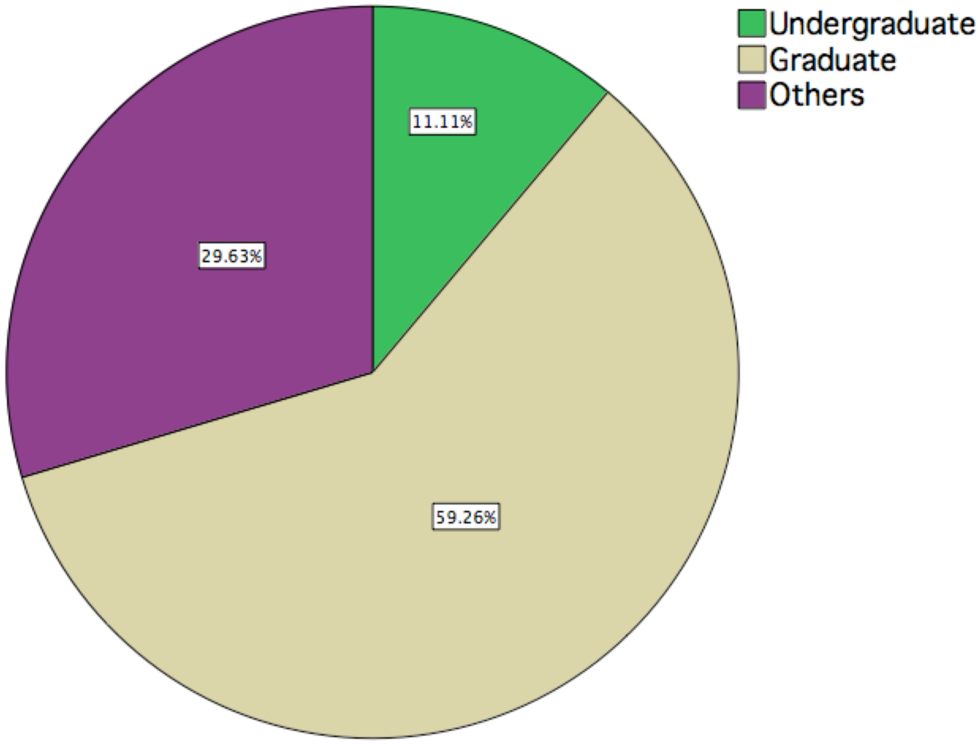

Figure 6.2: Learners' highest level of education.

Several questions in the pre-course survey explored the participants' specific goals and their motivation for studying the course. They were asked what they expected to achieve by taking the course. The most frequently stated reasons are shown in Figure 6.3. Most (over 60%) were motivated to learn new knowledge and skills directly related to the computing topics of the course. A further group (just under 10%) expressed their main objective as receiving a certificate rather than mastering the topic itself. A substantial minority (around 25%) were mainly driven by an interest in finding out about MOOCs and online learning and by a general curiosity to learn about the format. Over 5% of participants saw the course as a social experience in which they would be able to meet new friends.

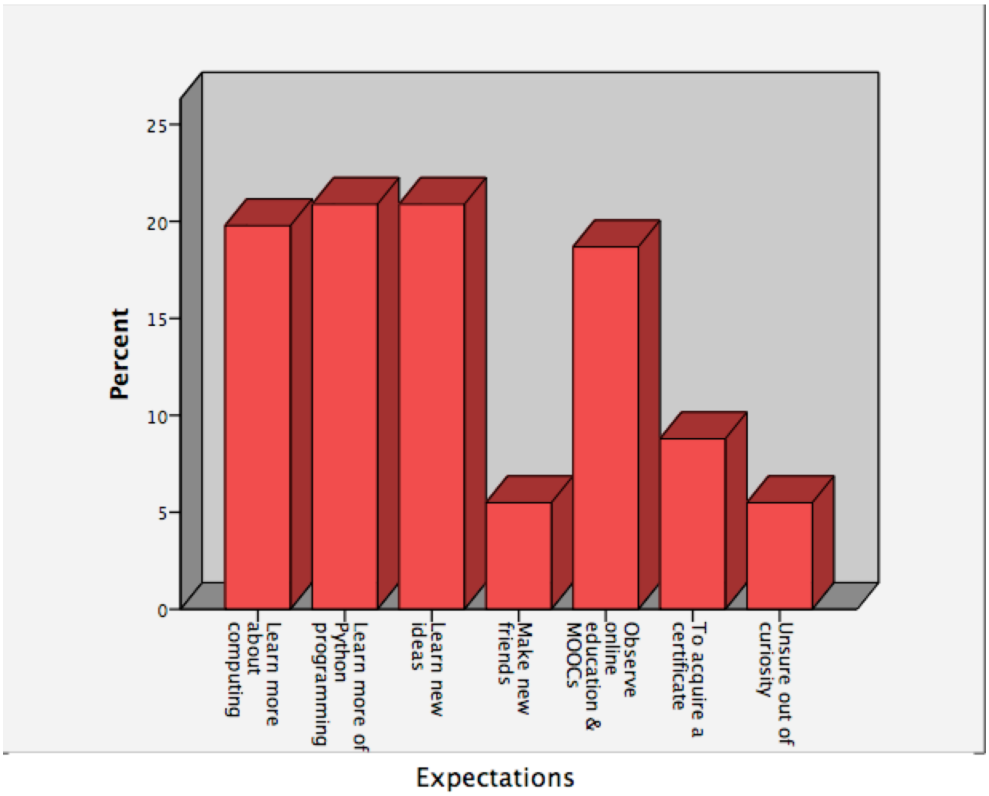

Figure 6.3: Learners' expectations.

The responses may be divided into two distinct categories: those participants for whom learning the subject was the primary motivation (about 60%) and those who had more abstract or tangential reasons for taking the course and who were less interested in mastering the subject (about 40%). The aims of the second group may be appropriate to their personal needs (finding out about MOOCs represents the acquisition of a different area of knowledge, and making friends is a valuable social function). However, these are not directly related to the learning objectives of the course itself. This supports the view that, because the goals differ between participants, no single simple measure can be effective in judging whether the course met the students' needs. Some of the objectives may lie outside the scope and intentions of the course providers, yet, these can nevertheless act as legitimate motivators for participants. Without asking each individual learner, it is not possible to know their objectives, whether the objectives have been met, or whether the course would aim to fulfil these objectives.

6.2.2 Visualisation of learning preferences

Figure 6.4 shows profiles of learners' preferred modes of learning including interactive learning, collaborative learning, instructor-led learning, and SDL. The learning profiles were created using the frequency of respondents' preferences from the survey questions. The question asked was 'What kind of online course delivery do you prefer?'. The learners could choose more than one option. Figure 6.4 presents some interesting results that suggest areas for further exploration. The profile of learners revealed that over 35% prefer interactive learning, while the second highest preference — through SDL — was very close at approximately 31%. The last two were instructor-led learning at 19% and collaborative learning preferences were the least at 15%. Research has shown that collaborative learning is a vital aspect of learning in a MOOC facilitating sharing knowledge and collaboration between learners of similar learning styles [284]. However, this study observed low levels of this learning habit compared to others.

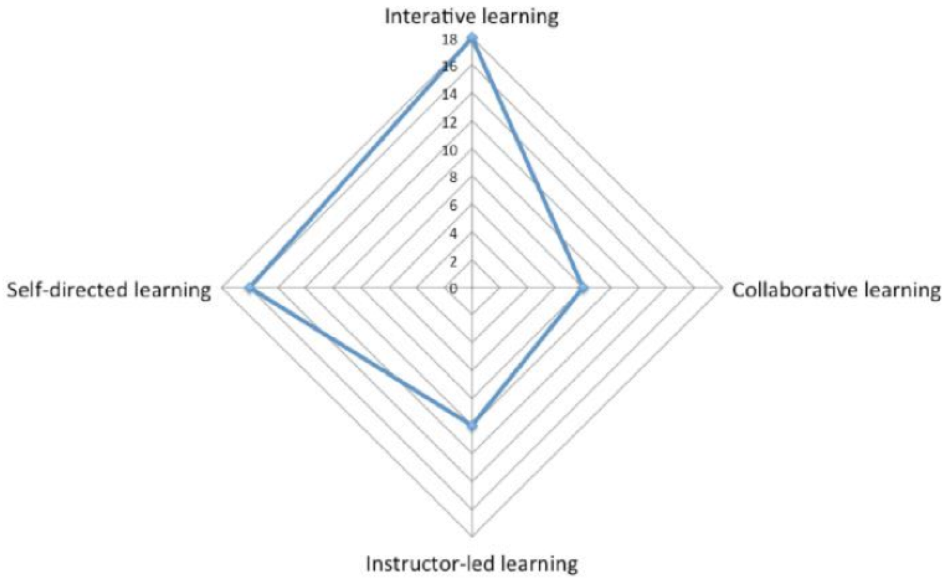

Figure 6.4: Learners' preferred mode of learning.

6.3 Measuring Self-Regulated Learning Skills

A small sample size of the enrolled participants (about 11 out of 107) completed the online SRL survey questions. The survey questions address six separate dimensions of SRL: goal setting, task strategies, time management, environment structuring, help seeking, and self-evaluation.

6.3.1 SRL survey responses

Table 6.1 shows the results obtained relating to SRL skills of course participants. The first column of the table indicates the SRL dimension evidenced by that question as follows: goal setting (GS), task strategies (TS), time management (TM), environment structuring (ES), help seeking (HS), and self-evaluation (SE). The percentage of participants selecting each of the 5-point Likert scale responses ranging from 1 to 5 (strongly disagree to strongly agree) is shown for each question in percentage, together with the average response for the item. Considerable variation in average responses (from 2.18 to 4.18 out of 5) indicates that some aspects of SRL are better developed than others.

Table 6.1: Responses to the MOSLQ survey.

		(%)					
	Survey Question	**1**	**2**	**3**	**4**	**5**	**Ave**
GSQ1	I know what I am going to achieve in this course	0	18.2	36.4	27.3	18.2	3.54
GSQ2	I have set aside time to study the course	0	9.1	36.4	54.5	0	3.45
GSQ3	I have high standards for my work on this course	0	0	27.3	63.6	9.1	3.82
GSQ4	I have set targets for all I want to achieve in this course	0	36.4	36.4	18.2	9.1	3.00
GSQ5	I do not see my engagement in the course as less important solely because it is an online course	9.1	9.1	0	63.6	18.2	4.09
GSQ6	I have written down the goals I plan to achieve by the end of this course	18.2	54.5	18.2	9.1	0	2.18
TSQ1	I work strategically to prioritise tasks to help me achieve my learning goals	0	0	27.3	63.6	9.1	3.82
TSQ2	I prepare for my online study by reading the suggested background learning materials beforehand	18.2	36.4	18.2	27.3	0	2.91
TSQ3	I set out my study agenda before engaging with the online resources	9.1	63.6	9.1	18.2	0	2.36
TSQ4	I am prepared to tackle any challenging aspects of the work in this course	9.1	18.2	54.5	18.2	0	2.82
TMQ1	I have planned ahead in order to devote the necessary time to my online studies	0	45.5	45.5	0	9.1	2.72
TMQ2	I find a good time to study when I won't be distracted	0	9.1	0	63.6	27.3	4.09
ESQ1	I choose my study location in order to avoid distractions	0	9.1	27.3	45.5	18.2	3.73
ESQ2	I find a comfortable place to study	0	9.1	0	81.8	9.1	3.91
ESQ3	I choose an appropriate place to work in order to study effectively	0	18.2	36.4	36.4	9.1	3.36
HSQ1	I plan to use the interactive communication channels provided to gain support from peers and tutors	18.2	45.5	27.3	9.1	0	2.27
HSQ2	I plan to participate in the course discussion forums in order to get the most out of the course	9.1	36.4	45.5	9.1	0	2.55
SEQ1	While engaging in this course, I will reflect on my study in each module	0	0	18.2	72.7	9.1	3.91
SEQ2	I will be proactive in engaging and reviewing progress in the learning path I select	0	0	9.1	63.6	27.3	4.18

The lowest score related to writing down goals. While participants mostly claimed to set high standards for their work, few were likely to focus on articulating the objectives of their study, and even if they did, most did not keep a record. At the other end of the scale, most participants agreed or strongly agreed that they would be proactive in engaging and monitoring their progress on their chosen learning path. The individual questions contribute to the six dimensions of SRL. Table 6.2 shows the results grouped by these dimensions, revealing a noticeable difference between the scores on each. Respondents self-reported being particularly effective at self-evaluation, which incorporates reflecting on their own learning and reviewing their progress. However, they were much less inclined to seek help. Previous research, as described in the literature review in Chapter 2, has noted the issue of low social participation by many learners. Our results show that a high proportion of learners set out with every intention of not engaging in forums (over 45% in our MOOC) or using other peer or tutor support channels (nearly 64%). Although these results are from just one small group of MOOC learners, they are nevertheless surprising and indicate an area for further investigation.

On any of the SRL assessment questions, to indicate a 'good' level of that particular skill, a learner should select either 'agree' or 'strongly agree'. That is, we would view a score of 4 or above as indicating good SRL in that area. Table 6.2 shows that the only dimension for which the average achieves this is self-evaluation. Therefore, the results indicate considerable room for improvement in all areas.

Table 6.2: Overall average result for each SRL dimension.

Dimensions	GS	TS	TM	ES	HS	SE
Results	3.35	2.98	3.41	3.67	2.41	4.05

6.3.2 Visualisation of SRL results

Figures 6.5 and 6.6 use radar charts to emphasise the contributions of the different SRL dimensions, providing a visual presentation of the overall SRL profile. Figure 6.5 underlines the fact that, even in dimensions with a score of above 3, there are individual questions indicating areas in which considerable improvement could be made. For example, goal setting receives a score of 3.35 but the recording goals score is only 2.18.

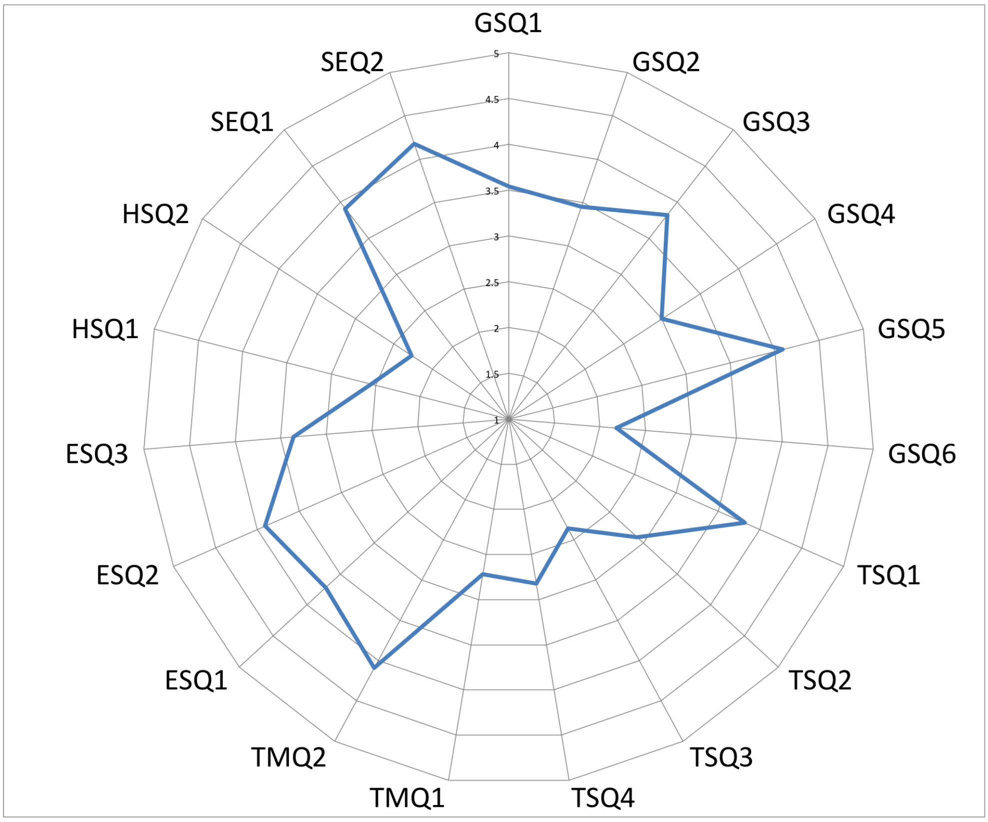

Figure 6.5: Visualisation of average SRL scores.

Figure 6.6 clearly shows the lack of intention to seek help among the group. It may be that MOOC learners do not expect this to be an effective method for them to study; however, it is concerning that some planned never to contribute or seek help in any way.

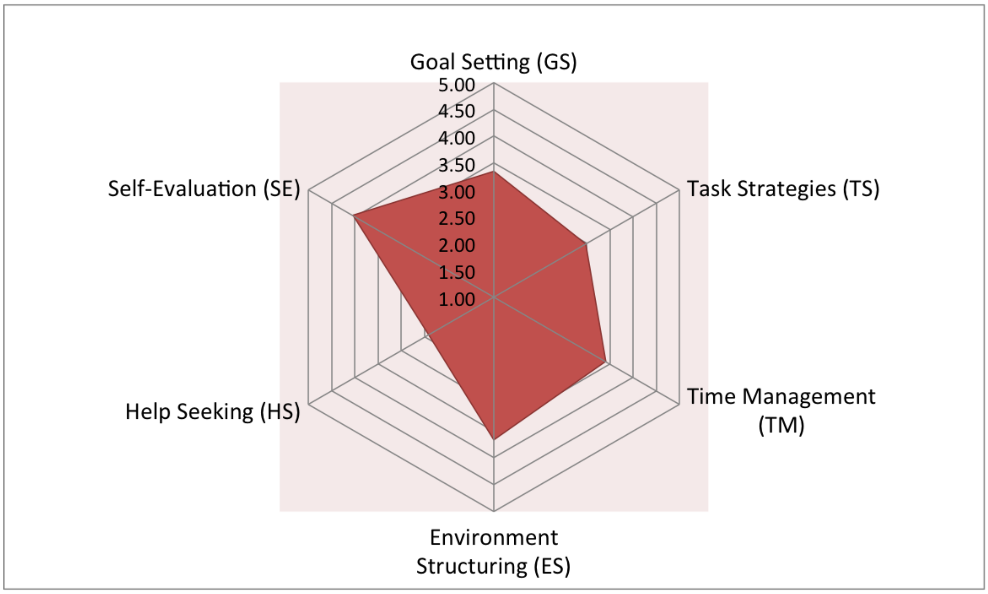

Figure 6.6: Visualisation of average SRL scores by dimension.

6.3.3 Results by individual learner

The results shown above represent the average position across the whole cohort and provide an indication of which SRL skills are under-represented in general. For each individual learner (and if the system is to provide personalised support) it is important to consider the individual profiles of each participant. Given the small number of respondents in our sample, it is possible to present the profiles for all 11. Table 6.3 shows the average SRL score for each learner. While there is one outlier in each direction (that is, one learner with an average of 4.33, another with average 2.67) most respondents had average scores of between 3 and 4. Given that the participants have a successful track record in formal education, and bearing in mind that a level of 3 represents a 'neutral' response to questions, these numbers are lower than might have been expected.

Table 6.3: Average SRL score for each learner.

	Average SRL Score
Learner 1	3.50
Learner 2	3.00
Learner 3	3.17
Learner 4	4.33
Learner 5	3.33
Learner 6	3.33
Learner 7	3.50
Learner 8	3.17
Learner 9	2.67
Learner 10	3.83
Learner 11	3.67

Figure 6.7 shows the learners' SRL scores. While two learners may have a similar average, their profiles may differ considerably, each having their own particular SRL strengths and weaknesses. Hence, to provide effective support for SRL, it is necessary first to perform a diagnostic assessment and second to provide different strategies depending on which dimensions are weak. Again, the low emphasis placed by all but one learner on help seeking is striking.

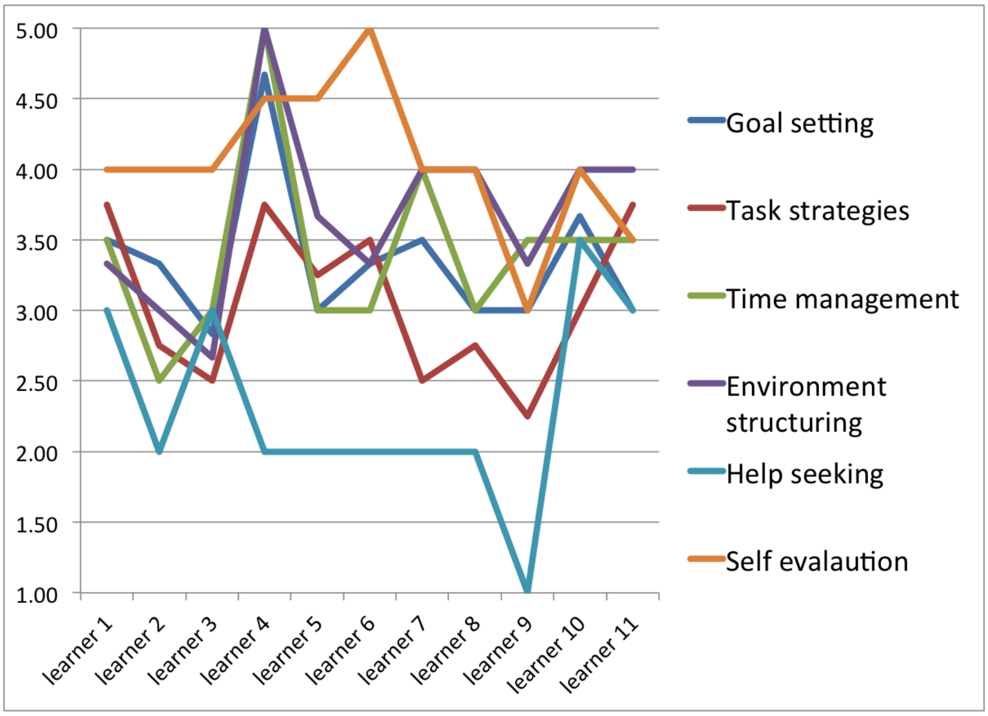

Figure 6.7: Individual learners' SRL scores for the six dimensions.

As well as investigating the MOOC learners' SRL levels, we were interested in finding the participants' preferences for mode of study and hence the likely choice of SDL paths. The two basic modes of study offered were self-directed and instructor-led. However, given that the platform supports switching between modes, it is also possible for learners to plan a combination of the two. This might also be regarded as a self-regulation strategy, as it involves choice and direction by the learner. Further, since the SRL survey was administered at the start of the course, some learners were not yet decided. The number of learners selecting each of these four options is shown in Figure 6.8. The results show that most learners would like either to direct their own learning entirely or to move between modes, suggesting that more self-direction would be highly desirable for many MOOC learners.

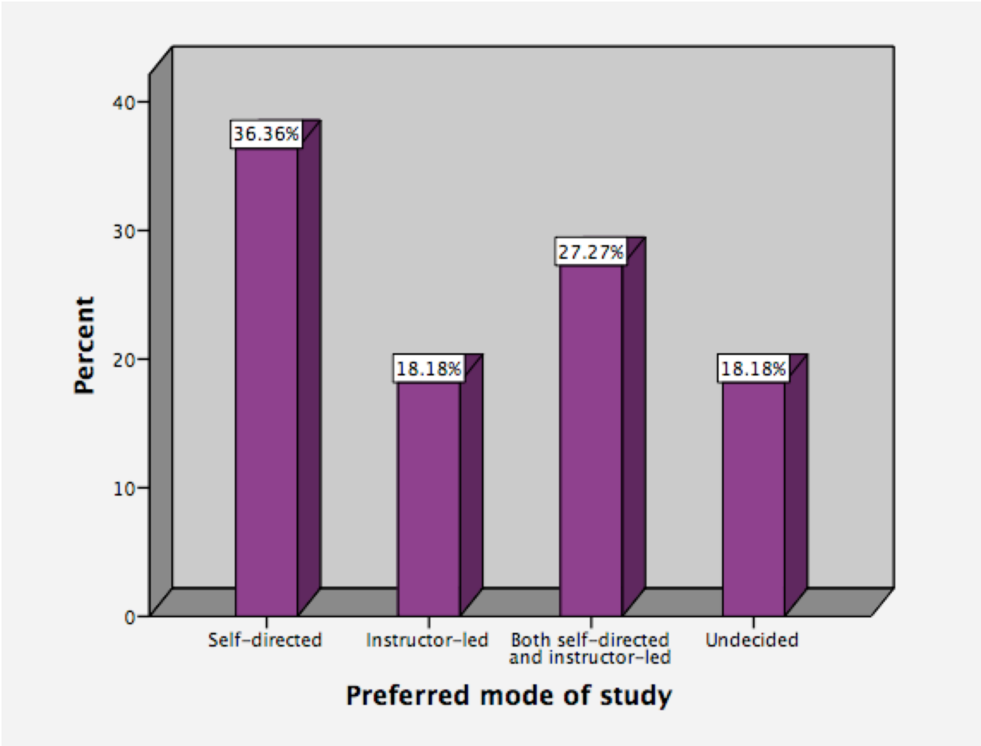

Figure 6.8: Visualising learners' preferred mode or path of study.

6.3.4 Relationship between SRL and study mode

We are interested to see whether levels of SRL skills relate to the participants' choice of learning path and, ultimately, to their attainment within MOOC study. At this point, the available data relate to the start of the course and the students' intentions towards mode of study. A quantitative analysis of the relationship would be preferable. However, for the small number of data points available in this preliminary study, it was not possible to meaningfully apply quantitative methods to the data. For example, although the Fisher exact test is applicable to small samples, a dataset of only 11 can never provide evidence for rejecting the null hypothesis. We therefore present the figures in a descriptive manner, viewing them as indicative only and providing suggestions for future investigation with larger numbers. Figure 6.9 present learners' SRL dimensions in relation to their preferred mode of study.

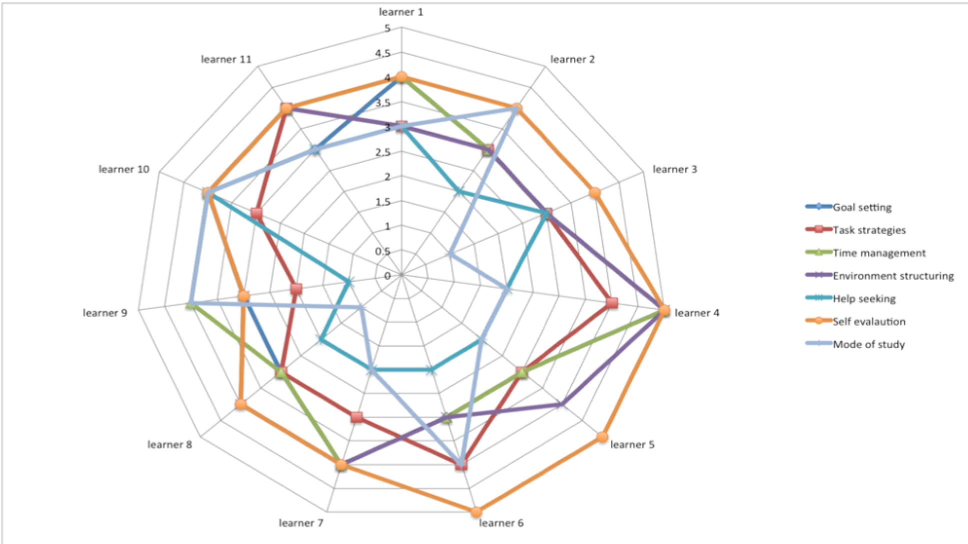

Figure 6.9: Learners' SRL dimensions in relation to their preferred mode of study.

Table 6.4 shows, for each dimension of SRL, the number of learners who selected a self-directed path and those who did not. The results are further differentiated between learners who show a higher or lower level of the SRL dimension under consideration. Thus, for each dimension, there is a grid representing the distribution across two separate variables (SRL dimension and choice of learning path). For the 'lower level' of learning skill we include values of less than or equal to 3, with values greater than 3 classified as 'higher level'. Similarly, options of 'self-directed' and 'mixed mode' are grouped together as 'learner directed' since these both indicate the intention of the learner to take control and switch as appropriate.

Table 6.4: Choice of learning path related to SRL levels.

Mode	**Goal setting high**	**Goal setting low**	**Total**
Instructor-led	1	3	4
Learner-directed	3	4	7
Total	4	7	11
	Task strategies high	**Task strategies low**	**Total**
Instructor-led	1	3	4
Learner-directed	2	5	7
Total	3	8	11
	Time management high	**Time management low**	**Total**
Instructor-led	2	2	4
Learner-directed	4	3	7
Total	6	5	11
	Environment structuring high	**Environment structuring low**	**Total**
Instructor-led	2	2	4
Learner-directed	4	3	7
Total	6	5	11
	Help seeking high	**Help seeking low**	**Total**
Instructor-led	0	4	4
Learner-directed	1	6	7
Total	1	10	11
	Self-evaluation high	**Self-evaluation low**	**Total**
Instructor-led	4	0	4
Learner-directed	6	1	7
Total	10	1	11
	Overall SRL high	**Overall SRL low**	**Total**
Instructor-led	3	4	7
Learner-directed	2	2	4
Total	5	6	11

In terms of these classifications, each dimension reveals a split between choice of study mode in which participants appear quite likely to choose either path whatever their SRL level. That is, there seems to be little indication that SRL levels affect choice of study mode. However, the results do indicate the more polarised positions regarding help seeking and self-evaluation. All but one participant falls into the low category for help seeking, but again there is little evidence of difference in choice between learning paths. Self-evaluation displays a reverse pattern, with all but one participant being classified as high in this dimension, although the choice of path seems little affected. The indications so far are that learners have definite preferences for their mode of study and the degree of autonomy they would like; however, this appears not to be related to their SRL skills. This may suggest that, although most learners would like to direct their own learning and decide on suitable objectives and the learning path, many may lack the necessary skills of self-regulation to be able to do this effectively. A further point is that the classifications used here may be overly generous. We have taken high to be anything above a neutral response — even if only slightly. It might be argued that it would be more appropriate to include a learner in this category only if they at least accept the SRL strategy stated. On this measure, only one dimension (self-evaluation) would be regarded as having a high average and only one participant would be classified as a generally effective self-regulating learner (high self-regulator).

6.3.5 Visualising SRL profiles for different study modes

Figures 6.10, 6.11, and 6.12 show profiles of SRL for the three study modes: self-directed, instructor-led, and combined, respectively. In each case, the profile was created by plotting the average score on each dimension for all learners choosing that mode of study. Although the diagrams are based on a small number of data points, they present some interesting features, which suggest areas appropriate for further investigation. The profile for students choosing the instructor-led mode is notable in that no score is higher than 4 (these students are classified as low self-regulators). There is therefore no aspect of SRL in which these learners deploy strong SRL strategies.

This contrasts with the participants opting for a mixed approach to study who score relatively highly in four dimensions, but with noticeably lower scores in help seeking and task strategies. The members of this group appear confident in their self-direction but have already decided that they will not seek help or take part in social learning activity. Although further work is needed, it may be the case that learners are so confident about their learning skills that they do not anticipate needing support, or that they do not realise the benefits of this type of interaction when engaged in online learning. The third group (those who choose SDL) includes more diversity in SRL levels but, in general, lies somewhere between the other two. This may suggest that, overall, learners are choosing their mode of study wisely (that is, greater direction for those who have lower levels of SRL skill). Additionally, learners with higher SRL skills recognise the benefits of blending self-direction with guidance when in unfamiliar territory and have the confidence to feel they can take control of directing their path to switch between the two modes as appropriate.

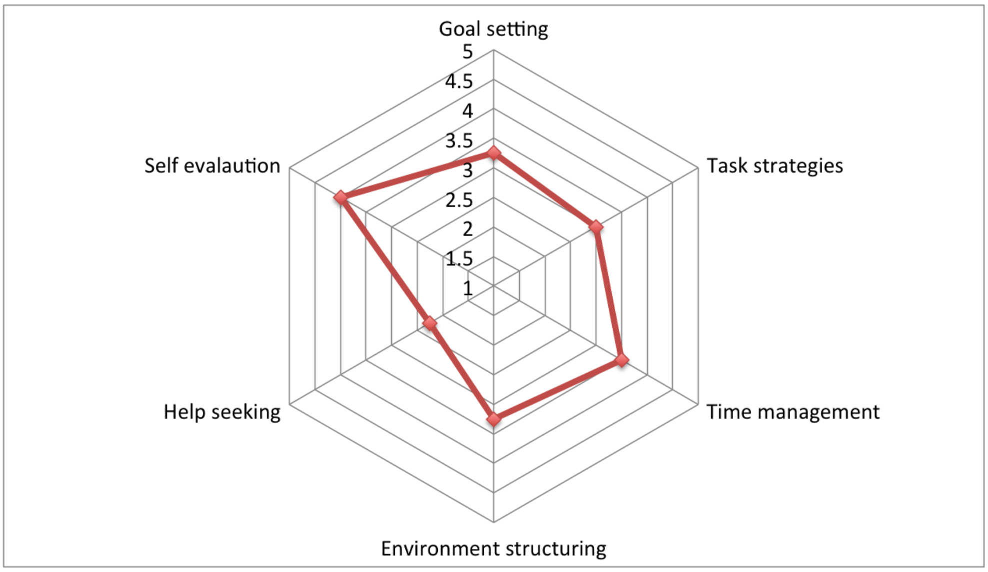

Figure 6.10: Average of SRL dimensions for learners who preferred an SDL path.

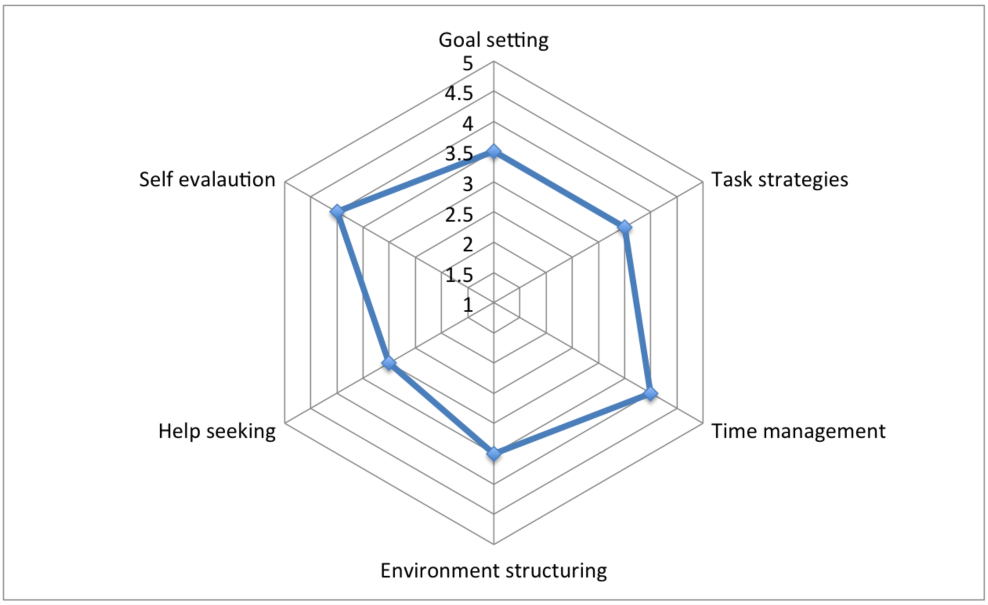

Figure 6.11: Average of SRL dimensions for learners who preferred an instructor-led learning path.

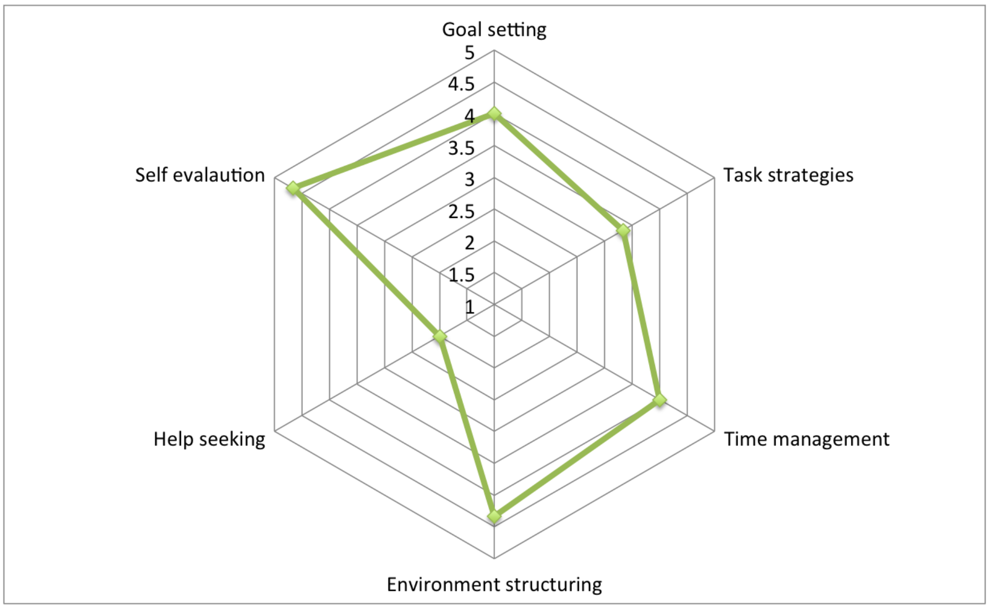

Figure 6.12: Average of SRL dimensions for learners who preferred to mix self-directed and instructor-led learning paths.

6.4 Discussion

The first research question in this chapter considers the extent to which MOOC learners choose to direct their own studies. Our data show a high demand for this to be made possible. Learners were very positive about moving from the current situation of monolithic, highly directed courses to one in which they could make informed decisions as to what to study next. The highly 'siloed' approach of most MOOCs means that they are viewed as standalone, and little attempt is made to provide access to constituent parts. There are some instances of linked MOOCs, but this is generally of a very basic, linear nature, such as an introductory MOOC, which must be completed before the advanced topic MOOC. Our prototype allows additional metadata to be attached to a section of learning resources, such as the prerequisites needed. Further, it provides links to where material on those prerequisites may be found. Currently, this is limited to within a single course, but a useful expansion would be to introduce a general scheme for recording such information and allowing cross-referencing between (parts of) different MOOCs.

Our second research question relates to investigating the implication of MOOC pedagogy and levels of SRL skills demonstrated by the learners. In the context of the trialled course, the levels of SRL overall (Table 6.2) showed considerable room for improvement, with self-evaluation being the only dimension scoring 4 or above (these participants are classified as high self-regulators in this dimension). Further, the two dimensions of help seeking and task strategies both scored below 3 (these participants are classified as low self-regulators in these dimensions), indicating the disinclination of the participants to engage in these activities. These are perhaps surprising results given the high levels of education of the participants and their obviously successful record of accomplishment of prior learning. As noted above, the concept of SRL is highly context dependent [357].

A group of learners may be experienced in a more traditional learning setting, and some of the necessary SRL skills may overlap, but there may be other aspects that need further development. Both help seeking and task strategies need different approaches in a MOOC setting. For example, students that are used to asking questions in a class may not translate this to the need to participate in peer discussions. Effective learners are aware of the strategies for maximising their learning. The stated intention of many of our learners not to participate in certain activities suggests that they may be unaware that, in an online context, activities such as engagement in course forums are not just peripheral and time-consuming, but provide purposeful and effective learning mechanisms. Even for MOOC participants with a strong learning record of accomplishment, it cannot be automatically assumed that this will translate directly to the requirements for effective MOOC study. The situation is likely to be even more challenging for those without a strong learning background. Currently, the lack of support in MOOCs for developing the necessary skills may render them inaccessible to many and may be a contributory factor in cases where participants do not achieve their learning objectives.

Investigating the relationship between SRL levels and choice of learning path, we found that learners in our MOOC were reasonably good at selecting a mode suitable to them. This is important, given McManus' findings on the need to match SRL to the appropriate study approach [208]. A symbiotic relationship is thus suggested between autonomy in a MOOC (that is, freedom of movement by the learner within the studying environment, without having to adhere to a predetermined order or sequence) and the development of effective SRL skills. Practising skills of self-direction improves SRL: higher levels of SRL allow the learner to benefit more from SDL. This suggests that to provide the best support for different learners, it is necessary to provide a level of adaptivity that can offer students different learning structures (and which can alter as the student's SRL skills develop).

Major MOOC providers have been criticised for enshrining a one-size-fits-all approach to course development, and some authors have started to explore models for more adaptive presentations [287]. However, adaptivity on a meaningful scale is notoriously difficult to achieve, both in terms of suitable platform and tools but also because of the skill needed to author effective adaptive courses. Hence, it seems that, while this is an exciting prospect, it is still at an early research stage. The lack of consideration for appropriate pedagogy in the rapid development of MOOCs means that little attention has been paid to how SRL should be contextualised and supported in this setting. Strategies for fostering SRL in e-learning can be implicit, in the sense that they are built in to the course, for example by choosing learning activities involving exercising and developing certain skills. They may also be explicit, directing students to reflect on exercising the skill and raising metacognition of the processes involved. The first step is to identify areas of weakness that should be targeted, and for this, an effective diagnostic tool (such as a pre-course survey) is needed. Our work explores one aspect in which users can be allowed to take responsibility for directing their own learning and preliminary results, suggesting this to be a viable means of introducing learner autonomy in a MOOC. Further aspects, such as guiding students towards explicit consideration and articulation of goal setting would not be difficult to introduce.

6.5 Summary

Current mainstream MOOC approaches fail to consider many aspects of pedagogy that educational research has long established to be beneficial for effective teaching and learning. Many MOOCs tend to be inflexible, one-size-fits-all courses that encourage passive engagement and allow little scope for students to direct and regulate their own learning. Our findings support previous research, which indicates that most MOOC participants are highly educated with a record of accomplishment of effective prior learning. However, our results indicate that this group of learners did not, as might be expected, score highly on many dimensions of self-regulation for effective online learning. Seeking help and social interaction strategies were very low, and strategies for effective task management (such as planning) were not highly developed. This accords with the contextualised nature of SRL, and we conclude that, even for participants with a record of accomplishment of educational achievement, it is not safe to assume that they will be effective at self-regulation in a MOOC context. Further, for other groups of learners with less formal educational background (the very learners to whom it has been suggested MOOCs might cater), the gap between SRL skills needed for success and those possessed is likely to be even greater. This indicates the need for MOOCs to incorporate ways to develop learners' SRL skills.

Second, we found that most learners were keen to direct their own learning paths and that those displaying the greatest levels of SRL planned to blend their own path-setting with following the instructor-led route in sections of the course that suited them. Thus, learners demonstrate their desire to be more autonomous and to develop individual learning goals. The eLDa platform, providing support for informed goal setting and effective navigation, has been well received by learners through their positive feedback and comments. Given that all learners are unique in their learning preferences and approaches and in the ways in which they might interact with an online course, a rich adaptive model might be considered a holy grail for MOOCs. However, this is difficult to achieve in practice. Providing a format in which sections of courses can be decoupled and where learners are supported in navigating them in a path suitable to them achieves a step in the right direction by making different routes feasible. It combines MOOC technology and ethos with a more 'learning object' type approach in which distinctive units of learning resources can be combined. Our platform currently allows this to be achieved within a single course. However, the approach can be extended to work between courses, allowing resources on necessary prerequisites to be referenced and obtained from courses.

Chapter 7

Case Study II : Blended Learning

This chapter addresses the second case study exploring SRL in the context of a MOOC used for blended-learning. The main research questions explored in this chapter are as follows.

RQ3. Does a learner's capacity for self-regulated study relate to the choice of learning paths and the ability to succeed in a MOOC?

RQ4. What levels of SRL skills are observed within students' learning in a blended-classroom context and an online course learning context? What are the areas of deficiency that need improvement?

7.1 Introduction

There is increasing evidence of MOOCs being used in the context of blended-learning, yet there is even less research into MOOC use for this type of learning and it associated pedagogy. In a blended-learning approach, students study both online and in a more traditional classroom setting [256]. Given the large number of MOOC courses now available and the high quality of the resources found within many, they may be able to provide a rich source of complementary material to be used in conjunction with face-to-face teaching. However, the two approaches represent very different styles of learning. For the combination to be effective, students must be effective learners in both approaches and must be able to bridge any gaps or differences between studying in different modes.

The current study investigates the concept of students' SRL in the context of a computing MOOC used as part of a blended-learning course presented to first-year undergraduates in the Department of Computer Science at Warwick University. The study explores students' capacity for e-learning self-regulation and the level of skills they report relating to different dimensions of SRL. This chapter reports results from a case study in which the eLDa platform was used to implement a MOOC which was used as part of a blended-learning course, providing a vehicle through which data were collected relating to both SRL and students' experiences within the blended course.

Section 7.2 briefly describes the concept of blended-learning. Section 7.3 describes the methods used in this chapter, the theoretical framework, and the data collection approaches. Section 7.4 describes the course platform, the purpose of the course design, and the research development. Section 7.5 presents the results, participant demographics, the instruments, and analysis. Section 7.6 addresses the measurement of SRL skills and presents the results by individual students. Section 7.7 presents the second phase of the study using a focus group discussion. It also presents the data interpretation results from the focus group students' interviews. Section 7.8 presents the deductive themes derived from the study and the survey questions to address the focus group transcript data. Section 7.9 presents inductive themes derived from the data interpretation. Section 7.10 presents the analysis of the statements from the focus group interviews. Section 7.11 consolidates the discussion of the investigation in this chapter. Section 7.12 summaries the chapter with an emphasis on the contributions and the implications of the study.

7.2 Blended-learning

The 'blended-learning classroom' is an approach to teaching and learning that incorporates online learning resources into a course partly delivered using a more conventional class setting [256]. Students studying in a blended mode engage with online course content anywhere at any time they choose, in addition to participating in face-to-face sessions in a 'bricks and mortar' classroom at their institution [125]. Blended-learning is a way to harness the many rich resources available on the Internet, while retaining the benefits of more traditional instruction available in on-campus courses [80]. Advantages include a reduction in cost, additional flexibility in study, and availability of different perspectives, presentations, and examples relating to the same topic [29, 276].

Blended-learning has also been associated with an increase in learners' autonomy, with students taking control of their studies and of the study environment outside the timetable of the instructional classes [80]. It is further suggested that, as well as reducing the limitations of time, environment, and resources, blended-learning can engender within the learners an enthusiasm to continue their work outside the classroom and to study consistently [80]. This may partly explain results linking blended-learning to improved retention rates and improved attainment [191].

To conceptualise and understand the pedagogical issues relating to blended-learning, theories and principles of education that have been applied variously to the online learning environment or to a traditional learning setting need to be modified [53]. Research findings relating to one mode of delivery may not always transfer to a different way of teaching and learning. Hence, to develop appropriate approaches to teaching and learning in a blended context, research is needed either to confirm findings previously established or to develop new, specific, evidence-based theory and practice. A variety of different models have been proposed for the blended-learning paradigm with, for example, varying techniques of managing the balance between classroom and online instruction [125]. This further underlines the need for understanding concepts and theories in the different contexts encountered.

The advent of MOOCs has provided a new class of freely-available learning resources that can potentially be used as part of a blended-learning experience. A limited amount of work is now emerging related to this. Initial results indicate that students respond well to the approach and that there is the potential for increasing student autonomy using this approach [55, 226]. However, there is still much to be learnt about the interpretation of existing theory in the different contexts and of the students' experiences of study in a blended MOOC classroom.

7.3 Method

The principle aim of this study is to investigate levels and patterns of self-regulation demonstrated by 'traditional' undergraduate students on a module conducted using a blended-learning approach. The students were all studying a conventional, face-to-face computing degree programme. The main mode of learning that most of the group had experienced up to this point was that of conventional classroom teaching. For the online component of the blended course, a MOOC was provided. This reinforced and developed the ideas introduced in class and allowed students to engage with the course and to interact with their peers and their tutor outside the class seminar times. Data relating to SRL were collected from the students using a modified version of an existing SRL survey instrument, as described below. The study was conducted with a class of students enrolled for an existing module and was investigated using a similar approach to action research. That is, an innovation was introduced to existing practice, with data collected to allow evaluation of the change and reflection on its implications for future practice.

7.3.1 Data collection

The study evaluated students' perspectives and SRL profiles within a blended seminar classroom trialled with first-year undergraduates studying a computing security course at the University of Warwick, United Kingdom. Two questionnaires were used to elicit data. The first was a general survey administered to understand the student demographics and their previous experience of blended-learning. This consisted of 37 questions and was administered early in the course to help shape the approach to teaching and to determine appropriate scaffolding to accustom students to the blended approach (as seen in Appendix E). The 37 questions comprised a combination of Likert-scale responses and free-response questions to gather students' thoughts and impressions of the MOOC-based blended approach. As described above, the MOSLQ survey instrument was used to investigate SRL, and this formed the basis of the second survey.

In this case study, as in the previous one, the MOSQL survey instrument was used to gather data relating to the six dimensions of SRL previously discussed and this formed the basis of the second survey. Several additional questions were incorporated into the second survey instrument to discover students' views on the appropriateness of the MOOC content, the supportiveness of the delivery method, and the general utility of the platform. In total, the second survey comprised 31 questions (as seen in Appendix F). The course had 136 registered students in total. The trial group consisted of 27 students who formed one seminar group. The first questionnaire was administered to all 27 students within the group. Voluntary participation was later sought for the SRL survey, with a paper copy of the instrument distributed in a face-to-face seminar session. There were 17 responses received for the second survey. The data collected from both surveys was subjected to both descriptive and predictive analysis, using the SPSS statistical tool.

7.4 The Course Platform

Provision of a MOOC enhances students' opportunities for learning and provides supplementary material. Existing best practice concerning digital and blended-learning was sought in the literature and was employed in the development of the course [204, 33, 34, 298, 39, 39]. We were careful to adhere to good pedagogical design practice so that no inconsistencies developed in the curriculum, teaching approaches, learning environments, and assessment procedures. The learning outcomes were carefully defined, with learning and teaching activities selected to meet these outcomes. A range of different materials was provided to support students with different learning preferences and approaches. Similarly, assessment tasks (both assessed and those provided for self-evaluation) were designed to test the students' understanding of the intended learning outcomes.

7.4.1 Research development

This research development, design, and construction lasted for five weeks in the first term in the 2015/16 academic year. The blended-classroom approach was used as the method of teaching during the seminar classes. For each of the weekly seminar sessions, the students participated in traditional face-to-face classes and, in addition asynchronous online learning resources.

The module highlights all the novel features and components of the eLDa MOOC system; for example, the students were free to engage with the course as they desired and at a self-directed pace. The resource content for the course was uploaded on a weekly basis before the seminar class so that the students could have access to the learning resources and study before the face-to-face classroom seminar. The five-week seminar course covered and was aimed at educating the students on computer security incidents, how to understand the day-to-day threats in computer security, and how to resolve these security issues in real-world scenarios. At the end of the semester, the students were requested to complete two different sets of survey questions: (1) the first is the same general survey question for blended-classroom instruction, as was administered at the beginning of the course, and (2) the second was the MOSLQ survey instrument, which was given to students at the end of the course. Results from both surveys were subsequently analysed and evaluated as presented in section 7.5.

7.5 Results

Data collected from the study were analysed in SPSS. Here, we report descriptive statistics from the evaluation, using these to suggest significant features of students' SRL and the patterns observed to occur in the blended-learning environment. Subsection 7.5.1 reports results from the first survey with 27 respondents, and onwards relates to the 17 responses to the second survey.

7.5.1 Research participants

The research sample consisted of 27 first-year undergraduate students of computer science. The first survey was conducted in the second week of the course. The 27 students consisted of one whole seminar group, plus some additional students from another seminar group whose tutor was absent that day. When students were asked if they had participated in a blended class before this study, over 85% (n = *23*) said they had not. Only 14.81% (n = *4*) said they had (Figure 7.1). Thus, most students were unfamiliar with this type of learning.

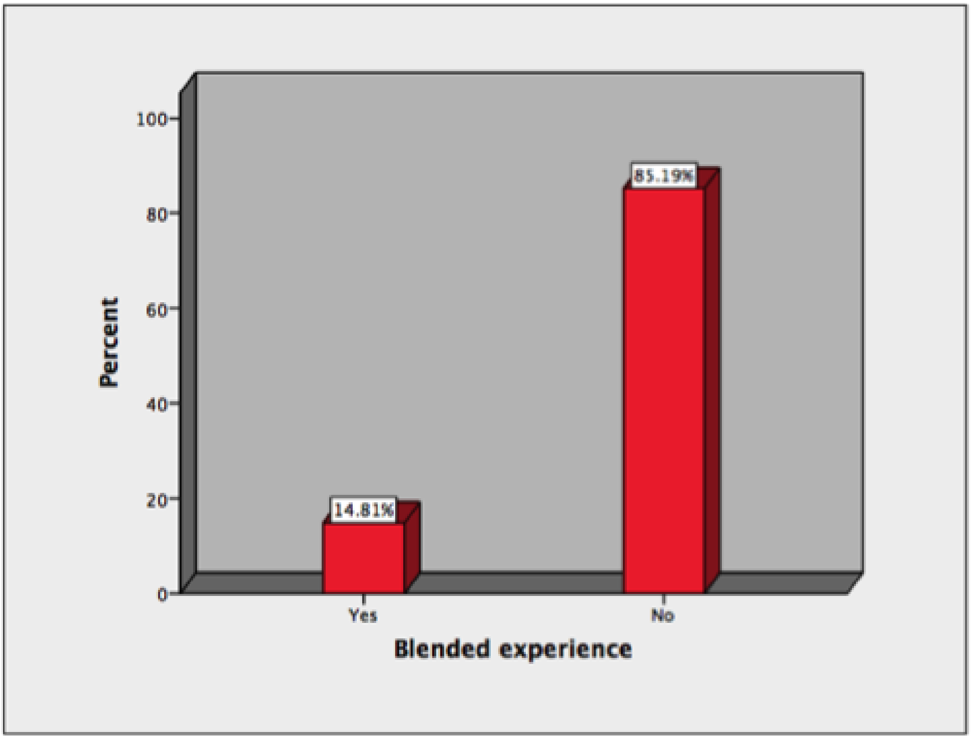

Figure 7.1: Percentage of students who have participated in a blended class.

The proportion of male to female students in percentage indicates approximately 93% (n = *25*) male and 7% (n = *2*) female, as illustrated in the gender demographic chart in Figure 7.2.

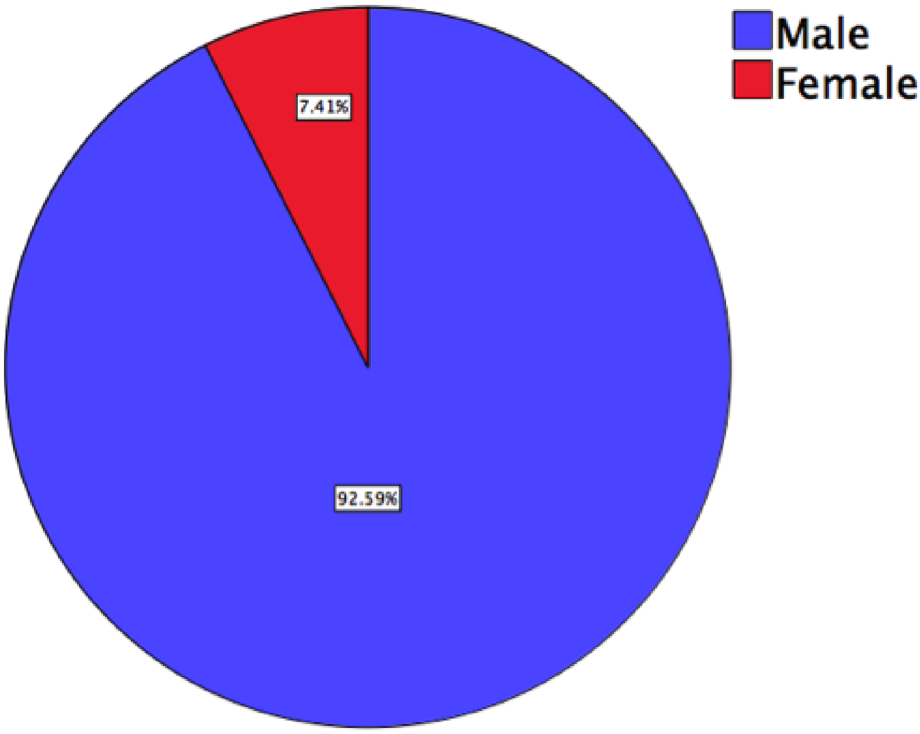

Figure 7.2: Gender demographic chart (n =27)

Table 7.1 illustrates the percentages of students who responded to statements related to the 'goal setting' dimension in the MOSLQ.

Table 7.1: Percentage of respondents to goal setting dimension.

				(%)		
	Survey Questions	**SD**	**D**	**N**	**A**	**SA**
GSQ1	I set goals to help me manage studying time for my blended-classroom lecture seminar.	5.9	23.5	11.8	52.9	5.9
GSQ2	I do not compromise the quality of my contribution because it is a blended class seminar.	0	0	29.4	58.8	11.8
GSQ3	I set reasonable goals to achieve during this semester's blended-classroom teaching.	0	17.6	29.4	47.1	5.9
GSQ4	I set standards for my weekly assignment after the blended class.	0	0	29.4	52.9	19.6
GSQ5	I keep a high standard for my studying in the blended online classroom seminar.	0	0	41.2	58.8	0

Table 7.2 shows the percentages of students who responded to statements related to the 'task strategies' dimension in the MOSLQ.

Table 7.2: Percentage of respondents to task strategies dimension.

		(%)				
	Survey Questions	**SD**	**D**	**N**	**A**	**SA**
TSQ1	I read aloud while engaging with the instructional material in this blended class to avoid distractions.	23.5	17.6	41.2	11.8	5.9
TSQ2	I prepare my questions before contributing in this blended class or any online discussion.	5.9	29.4	58.8	5.9	0
TSQ3	I find the solutions to problems in the blended class or any online courses aided me to master the content.	0	5.9	23.5	58.8	11.8
TSQ4	I try to take in more notes during the blended-classroom seminar to improve my ability to study.	0	17.6	41.2	29.4	11.8
TSQ5	I studied the blended content before coming to the seminar class.	5.9	23.5	41.2	29.4	0
TSQ6	I engage with the blended-classroom after each week's seminar to gain more understanding of the lesson.	0	35.3	41.2	23.5	0

Table 7.3 illustrates the percentages of students who responded to statements related to the 'time management' dimension in the MOSLQ.

Table 7.3: Percentage of respondents to time management dimension.

		(%)				
	Survey Questions	**SD**	**D**	**N**	**A**	**SA**
TMQ1	I allocate some time to my online blended-classroom seminar to acquire more knowledge.	0	23.5	41.2	23.5	11.8
TMQ2	I try to schedule some time every week to prepare for my online blended-classroom seminar.	18.8	18.8	37.5	25.0	0
TMQ3	I allocate some time every week to engage with the blended-classroom extra course resources.	5.9	23.5	58.8	11.8	0
TMQ4	I distribute my study time evenly between my courses and some time to the blended online seminar classes.	0	23.5	35.3	41.2	0

Table 7.4 depicts the percentages of students who responded to statements related to 'environment structuring' dimension in the MOSLQ.

Table 7.4: Percentage of respondents to environment structuring dimension.

				(%)		
	Survey Questions	**SD**	**D**	**N**	**A**	**SA**
ESQ1	I choose my preferable environment to study to avoid any distraction.	0	5.9	17.6	58.8	17.6
ESQ2	I decide on a comfortable place to do my studying.	0	0	11.8	70.6	17.6
ESQ3	I know the proper location where I can study efficiently for my online blended seminar.	0	0	23.5	58.8	17.6
ESQ4	I choose a certain period with less noise for my blended-learning.	0	29.4	23.5	41.2	5.9

Table 7.5 shows the percentages of students who responded to statements related to the 'help seeking' dimension in the MOSLQ.

Table 7.5: Percentage of respondents to the help seeking dimension.

				(%)		
	Survey Questions	**SD**	**D**	**N**	**A**	**SA**
HSQ1	I find a colleague who is knowledgeable in the course content so I ask him or her when I need any help.	5.9	17.6	17.6	35.3	23.5
HSQ2	I share my problems with my colleagues online to discuss and find a solution.	0	23.5	52.9	11.8	11.8
HSQ3	Sometimes I meet my classmate one-on-one to discuss exercises and assignments.	5.9	29.4	11.8	29.4	23.5
HSQ4	I am persistent in getting help from the seminar tutor though email.	5.9	23.5	35.3	35.3	0

Table 7.6 illustrates the percentages of students who responded to statements related to the 'self-evaluation' dimension in the MOSLQ.

Table 7.6: Percentage of respondents to self-evaluation dimension

		(%)				
	Survey Questions	**SD**	**D**	**N**	**A**	**SA**
SEQ1	I summarise my blended-classroom learning to examine my understanding of what I have learnt.	5.9	17.6	47.1	29.4	0
SEQ2	I ask myself a lot of questions about the online resources while studying for the blended-classroom seminar.	11.8	23.5	58.8	5.9	0
SEQ3	I communicate with my classmates to find out if I understood the online blended seminar course.	11.8	11.8	41.2	35.3	0
SEQ4	I discuss with my classmates to see whether what I understood during the blended classroom is what they understand as well.	11.8	17.6	29.4	41.2	0

Goal Setting: The goal setting question presents a response to 'I set goals to help me manage studying time for my blended-classroom lecture seminar'. The result indicates that 52.94% agreed with the statement, as seen in Figure 7.3.

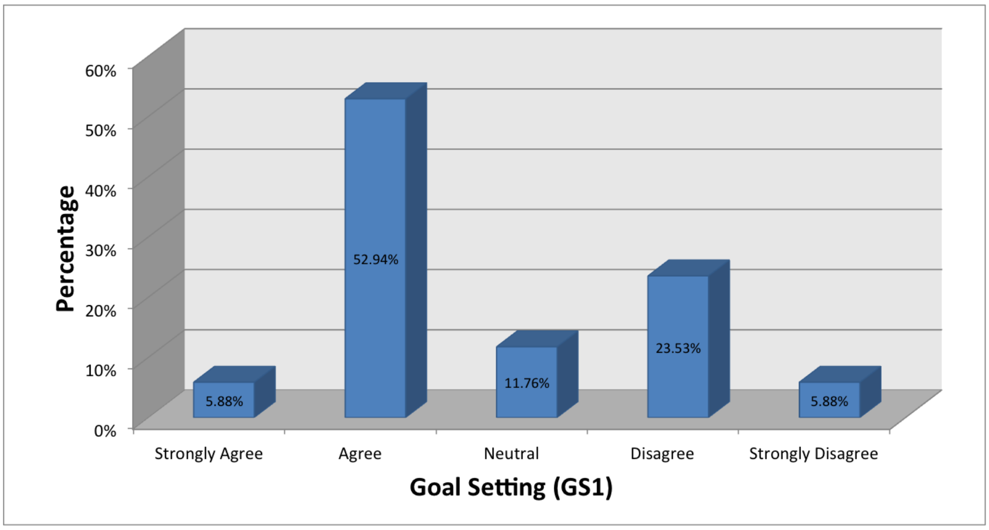

Figure 7.3: Set goals to help manage blended-classroom lecture.

Figure 7.4 indicates response to ‘I set standards for my weekly assignment after the blended class’. It shows over 70% of the students said they set standards to achieve success in their weekly assessment.

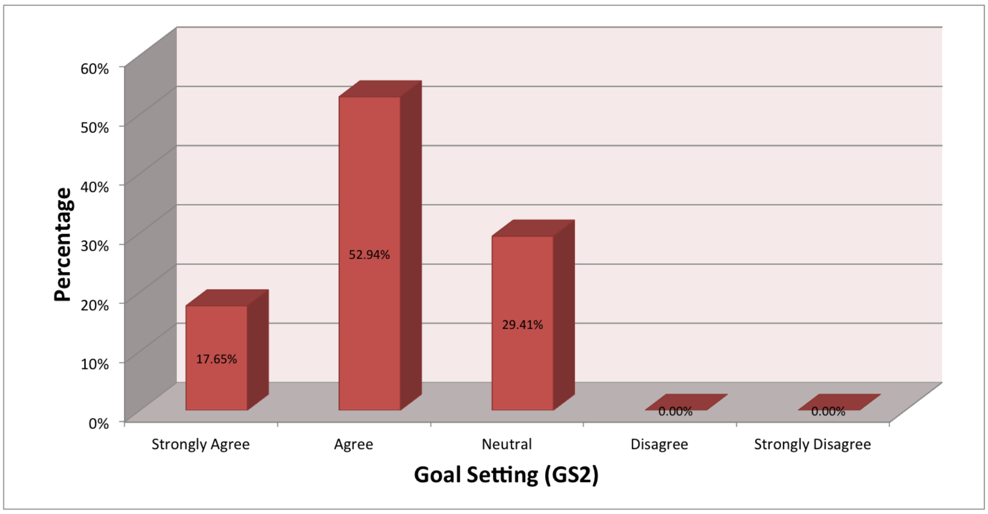

Figure 7.4: Set standards for weekly assignment.

In response to ‘I do not compromise the quality of my contribution because it is a blended class seminar’, reveals that 58.80% of the students agreed and 11.80% strongly agreed that they take their contribution in the blended class learning very seriously in order to benefit from the course content (as seen in Figure 7.5).

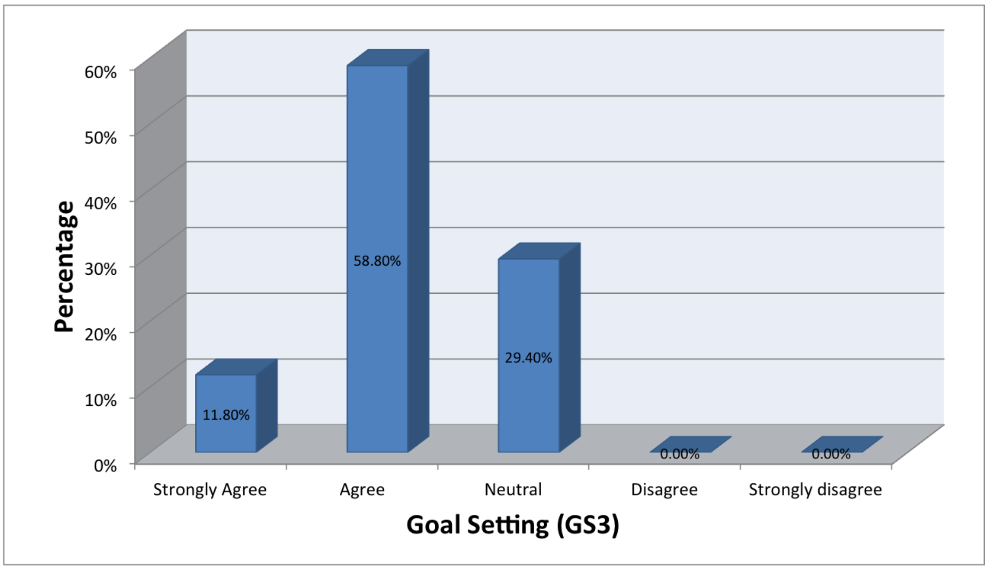

Figure 7.5: Quality of the blended class contribution.

Figure 7.6 indicates responses to 'I set reasonable goals to achieve during this semester's blended-classroom teaching', this result reveals that 53% of the students agreed to the statement that they set goals to achieve from the course. This was made possible because they could access the course beforehand and planned ahead of their studies. Goal setting is one of the most crucial dimensions in self-regulated learning. For any student to study effectively, knowing what to expect matters and make them to be more focus on their target.

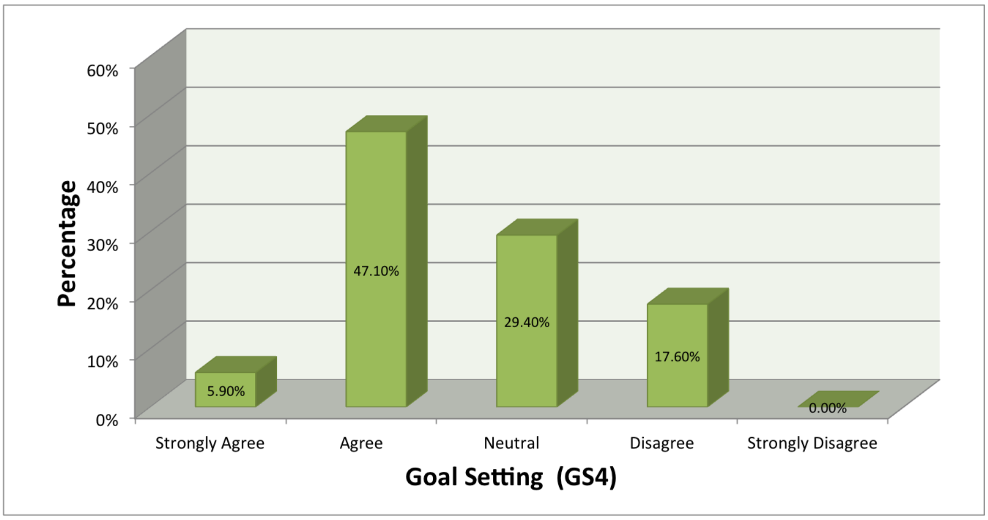

Figure 7.6: Reasonable goal to achieve during the blended class.

Task strategies: In the task strategies dimension, response to the statement 'I find the solutions to problems in the blended class or any online courses aided me to master the content' reveals that 52.94% of the students agreed with the statement and 11.76% of students strongly agreed. This indicates that the majority of the blended-learning students find the solutions to problems during the course very useful to help with their studying patterns, as seen in Figure 7.7.

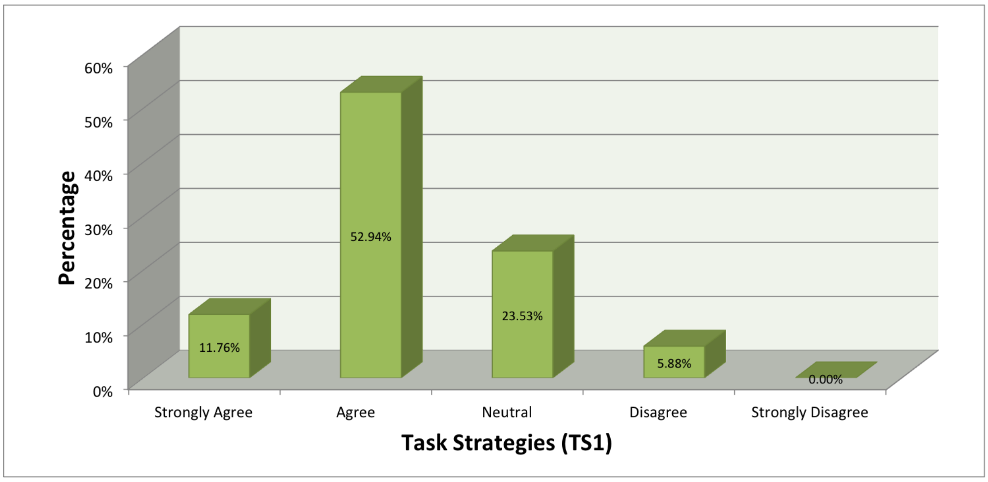

Figure 7.7: Solutions to problems aided mastering of content.

Figure 7.8 shows the response to ‘I prepare my questions before contributing in this blended class or any online discussion’. The results show that over 58% of students neither agreed nor disagreed with this statement, and over 29% of the students disagreed, while only just over 5% agreed. This statement confirmed that the students in this study were new to this method of learning, as stated earlier.

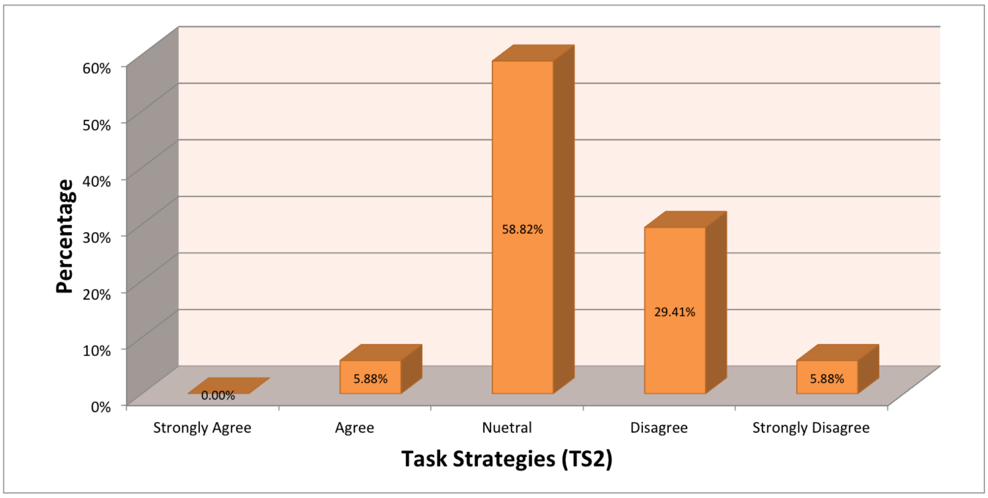

Figure 7.8: Adequate preparation of questions for contribution.

In response to the survey question on ‘I keep a high standard for my studying in the blended online classroom seminar’, this result indicates that 58.80% agreed with the statement that their standards are maintained in the study to attain the full knowledge of the blended-classroom course (as illustrated in Figure 7.9).

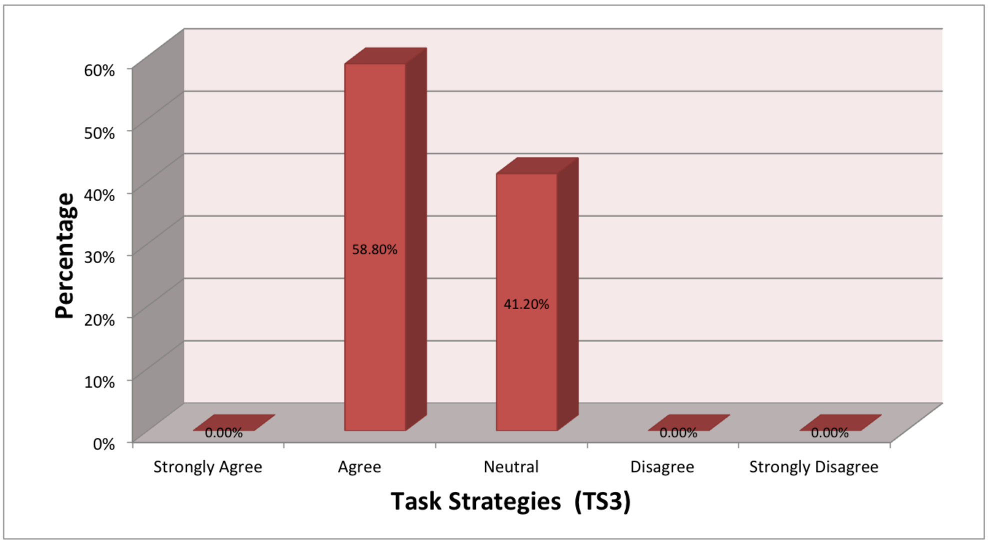

Figure 7.9: High standard for studying in blended-learning environment.

In response to 'I try to take in more notes during the blended-classroom seminar to improve my ability to study', reveals that 29.40% of the students agreed with the statement and that 11.80% of the students strongly agreed, while 41.20% of the respondents neither agreed nor disagreed with the statement. The results revealed that most of the learners show less positive self-regulation dimension in this case (as seen in Figure 7.10).

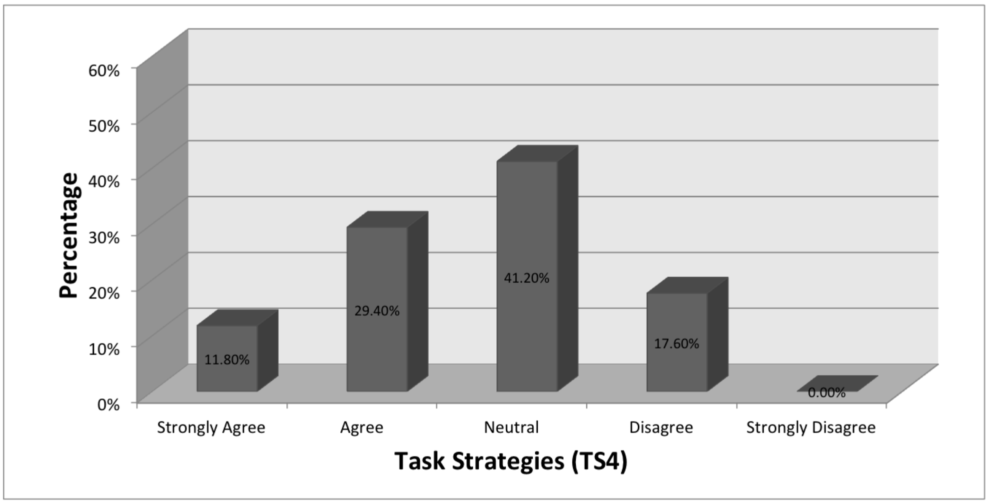

Figure 7.10: Taking more note during blended classroom seminar.

Figure 7.11 shows the response to ‘I studied the blended content before coming to the seminar class’. The results show that 29.4% of the students in the seminar class prepared before attending the class by studying the online resources. They could study and prepare ahead of their blended class, using the available resources at their disposal.

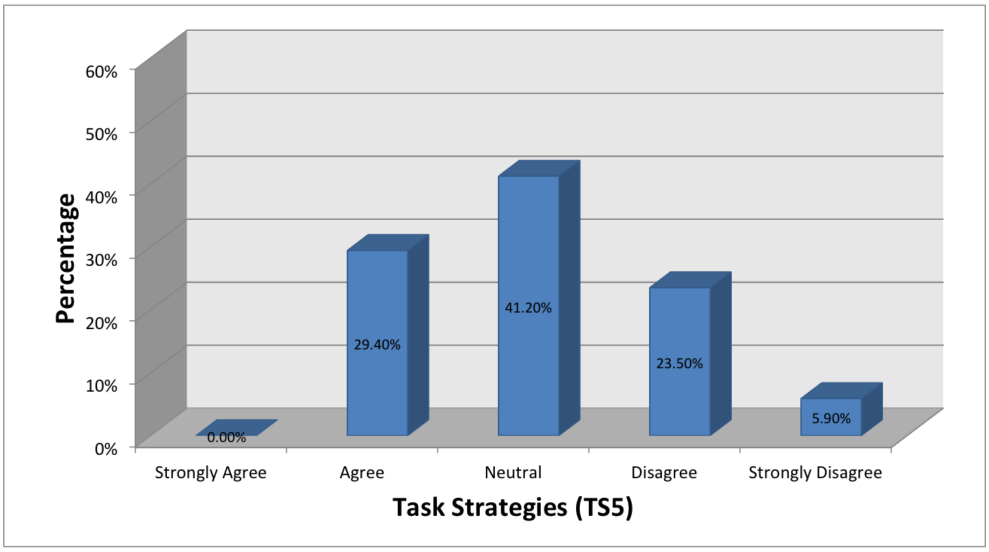

Figure 7.11: Adequate preparation for the seminar class.

Time management: When students were asked about their time management skills in this statement, ‘I allocate some time to my online blended-classroom seminar to acquire more knowledge’, only 35.29% agreed or strongly agreed (as shown in Figure 7.12). This is a similar profile to responses for other questions in the time management dimension.

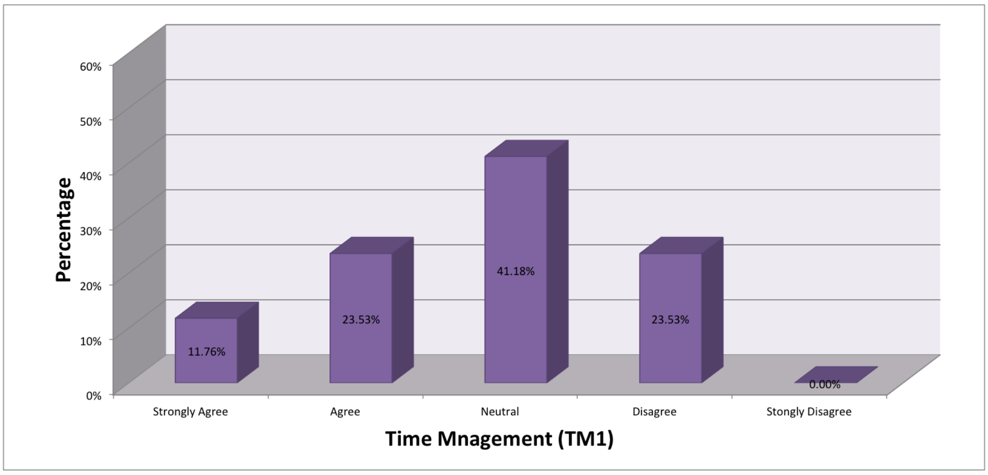

Figure 7.12: Allocation of time to acquire knowledge.

Figure 7.13 is in response to the statement ‘I try to schedule some time every week to prepare for my online blended-classroom seminar’. This reveals that about 25% of the students agreed that they set aside preparation time before engaging with the weekly seminar component of the blended-learning course. Slightly over 37% disagreed.

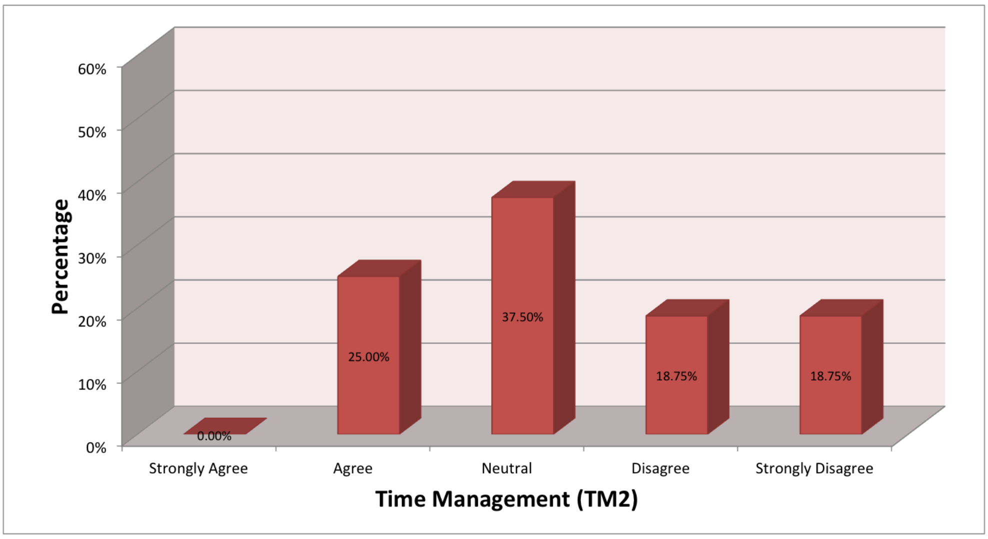

Figure 7.13: Scheduling time for blended-classroom seminar.

Figure 7.14 in response to the statement 'I distribute my study time evenly between my courses and some time to the blended online seminar classes'. The results reveal that 41.2% of students agreed they were able to distribute their time evenly across their studies, while 23.5% disagreed.

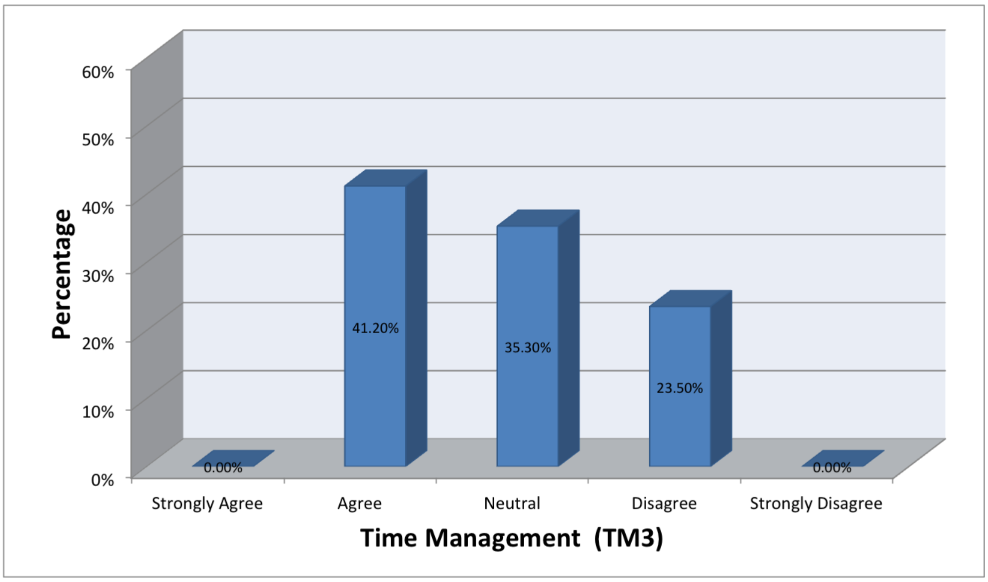

Figure 7.14: Equal distribution of time across study.

Environment Structuring: The students in the study showed evidence of their individuality and preference of study environment when they were asked to respond to the statement, 'I choose my preferable environment to study to avoid any distraction'. The majority of the students were positive in their responses. Most of the students (58.82%) agreed with the statement, while 17.65% strongly agreed, as illustrated in Figure 7.15.

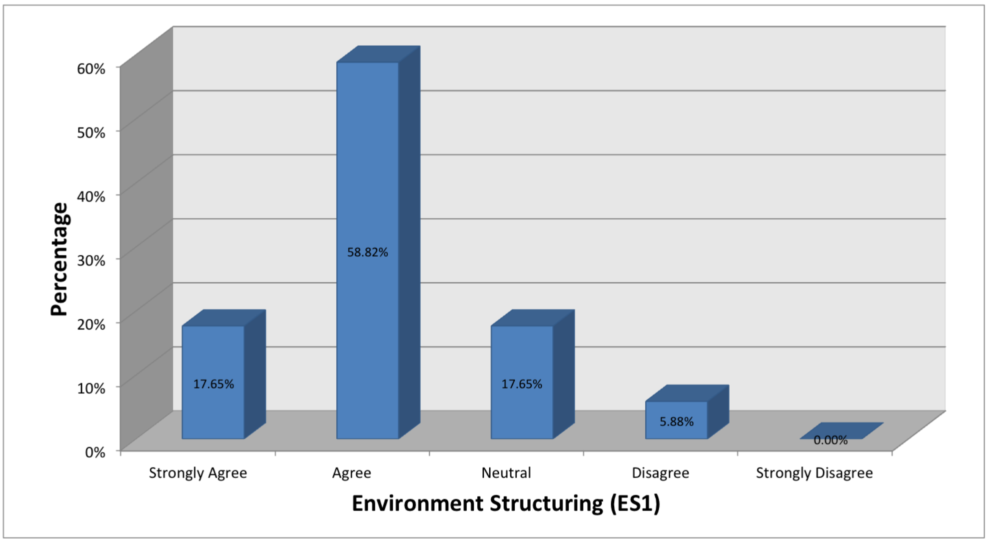

Figure 7.15: Preferred environment to study.

When the students in this study were asked to respond to the statement 'I chose a certain period with less noise for my blended-learning', most of the respondents at about 47% agreed that they selected better times and a quiet environment to study. This was to be surrounded with a nice atmosphere with less noise so that they could have better understanding of their studies, as shown in Figure 7.16.

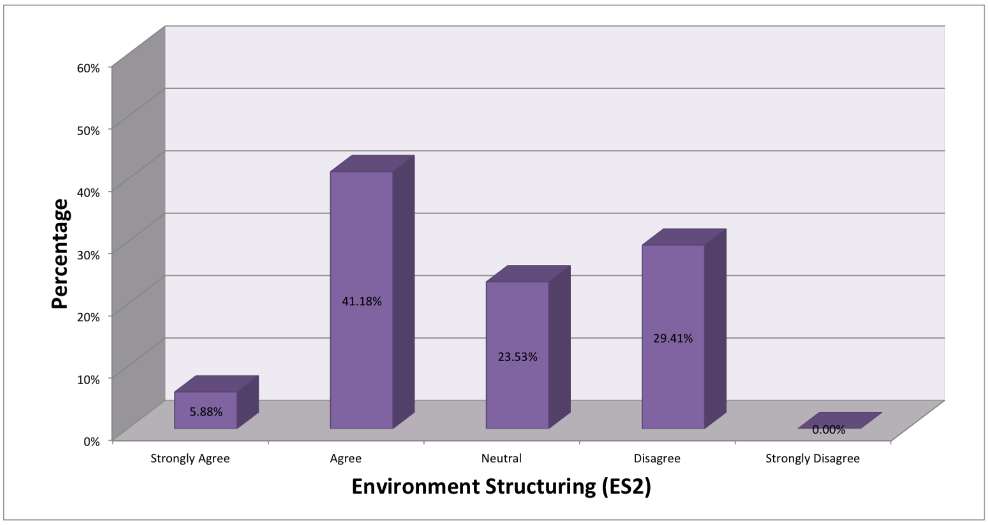

Figure 7.16: Period with less noise for blended-learning.

This dimension is related to the explicit nature of the surrounding in which the students learn in order to avoid distractions. When participants were requested to respond to 'I decide on a comfortable place to do my studying', this result reveals 88.2% of the students agreed with the statement and strongly agreed that they chose a suitable place to study in order to avoid any distractions (as illustrated in Figure 7.17).

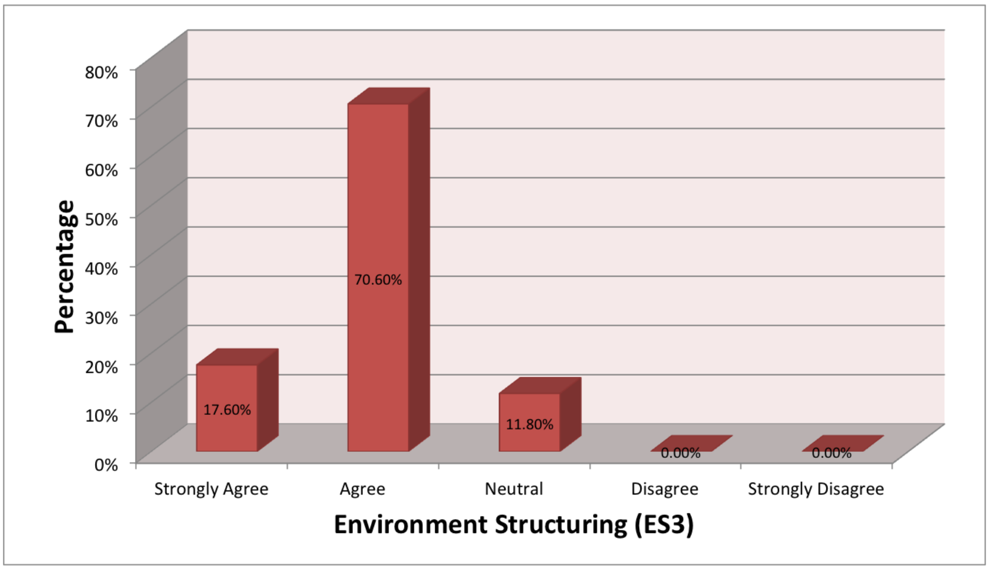

Figure 7.17: Comfortable place to study.

Figure 7.18 in response to the statement 'I know the proper location where I can study efficiently for my online blended seminar' reveals that 58.8% of students in the study agreed that they know where to study effectively, while 17.6% of students strongly agreed to the statement.

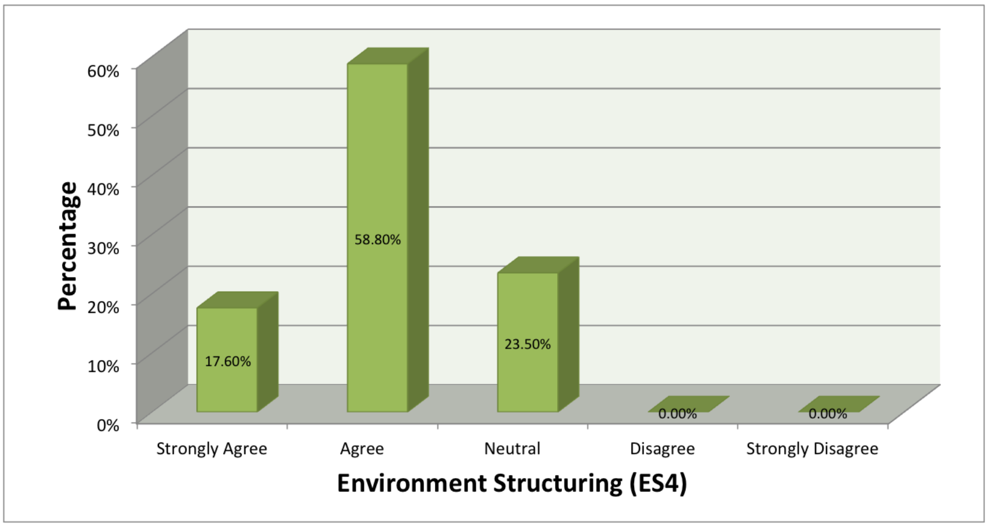

Figure 7.18: Knowing proper location for efficient study.

Help seeking: Regarding the help seeking statement, 'I find a colleague who is knowledgeable in the course content so I ask him or her when I need any help', reveals that 35.29% of the students agreed with the statement and 23.53% strongly agreed, as seen in Figure 7.19. This result indicates students' willingness to ask for help both from their peers and tutors.

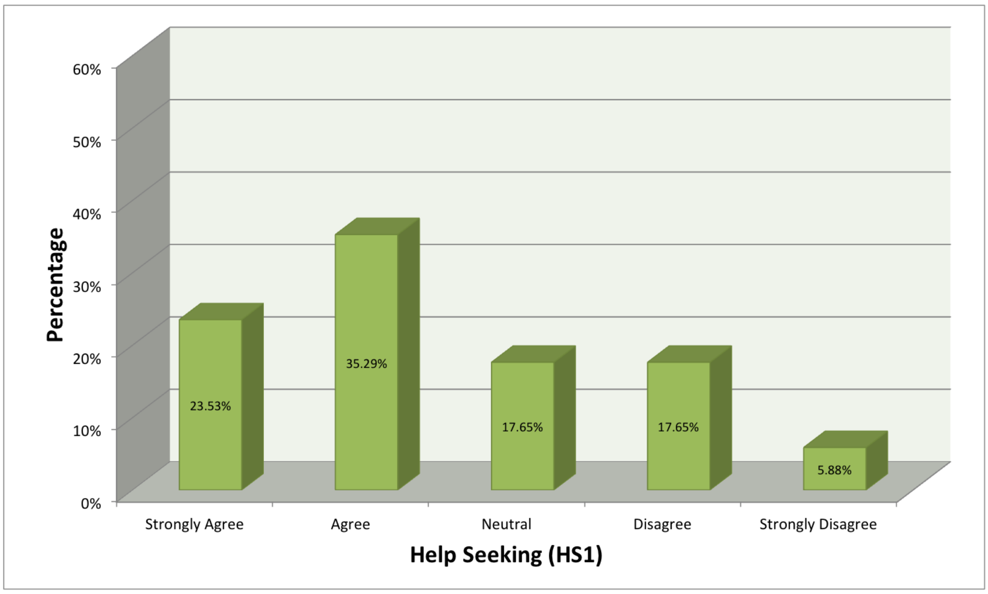

Figure 7.19: Seek help from knowledgeable colleague.

Figure 7.20 shows the students' response to the statement 'Sometimes I meet my classmate one-on-one to discuss exercises and assignments'. This indicates that the majority of the students (over 52%) sometimes like engaging in group learning with friends.

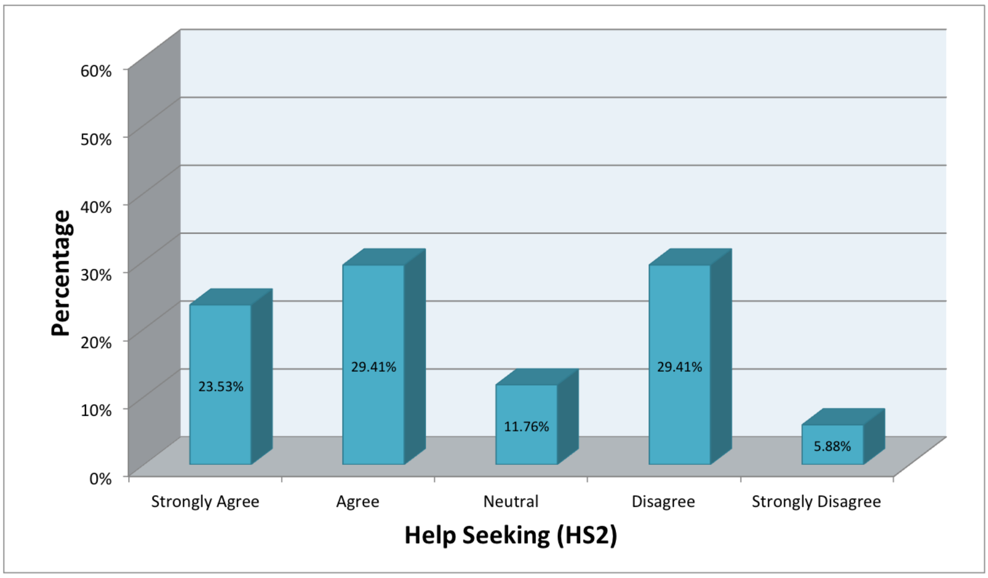

Figure 7.20: Meeting classmate to discuss problems.

Self-evaluation: In terms of self-reflection or self-evaluation while studying, the students' responses to the statement, 'I summarise my blended-classroom learning to examine my understanding of what I have learnt', shows that 29.41% agreed, as revealed in Figure 7.21. This reveals that very few students are willing to give an accurate response to the question, or this may be because they are new to this blended-learning, they could not fully understand the importance of self-evaluation while studying.

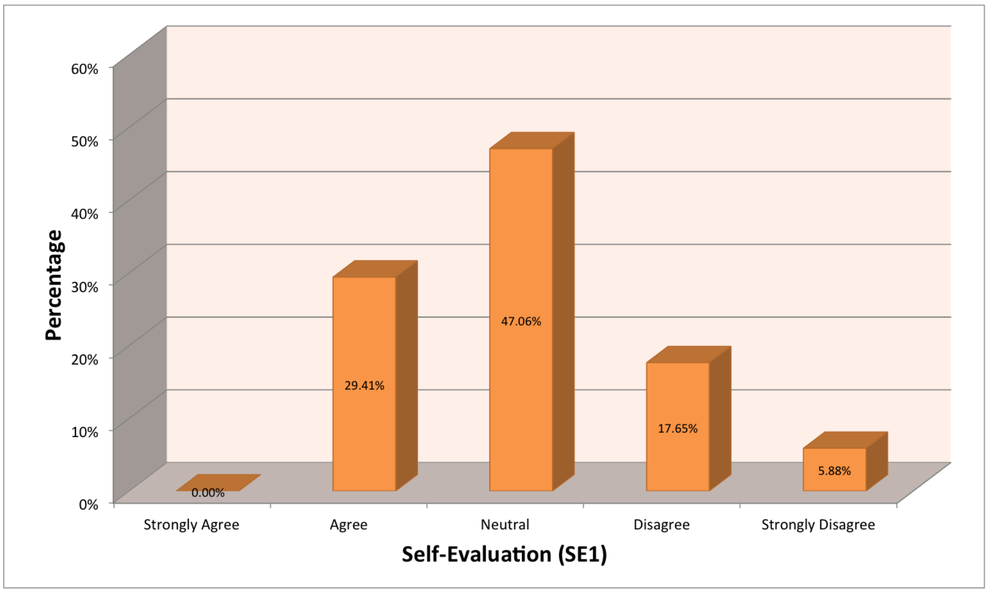

Figure 7.21: Summarise blended-learning to examine understanding.

The study shows that on their own, the students discussed with their friends to reflect if what they have studied and understood in the blended class is what others understood as well. Figure 7.22 reveals this in the response to the statement 'I discuss with my classmates to see whether what I understood during the blended-classroom is what they understand as well', shows that 41.18% of the students agreed that they discuss with their classmates to confirm whether what they understood from the blended-learning is the same.

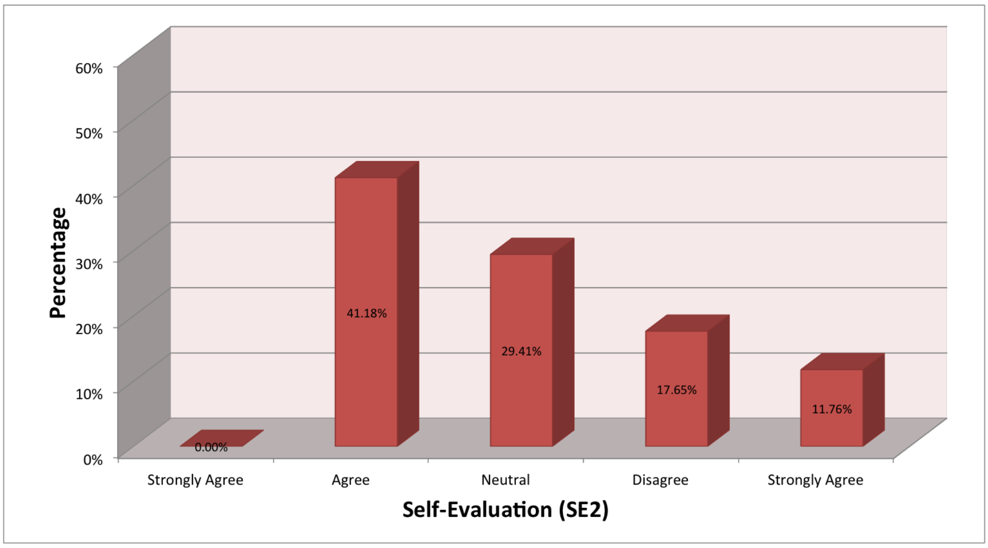

Figure 7.22: Discussion with classmates to confirm similar understanding.

7.6 Measuring Overall Self-Regulated Learning Skills

The previous section presented indicative questions from each of the SRL dimensions showing responses, to these specific questions. Overall, the six dimensions were evidenced with the following numbers of questions: goal setting (GS): 5, task strategies (TS): 6, time management (TM): 4, environment structuring (ES): 4, help seeking (HS): 4, and self-evaluation (SE): 4. These questions all had a 5-point Likert response format, with values ranging from strongly agree to strongly disagree. To calculate an overall score for each dimension, a numerical value was attached to each response level from 5 for strongly agree to 1 for strongly disagree.

Figure 7.23 shows the average scores for each question asked. It shows that, even within a single dimension, scores are not necessarily consistent. Hence, there are specific areas of each dimension that might be considered targets for improvement. For example, support may be needed for task strategies regarding TSQ1: 'I read aloud while engaging with the instructional material in this blended class to avoid distractions' and TSQ2: 'I prepare my questions before contributing in this blended class or any online discussion'. However, students are generally proficient in TSQ3: 'I find the solutions to problems in the blended class or any online courses aided me to master the content' and TSQ4: 'I try to take in more notes during the blended-classroom seminar to improve my ability to study'.

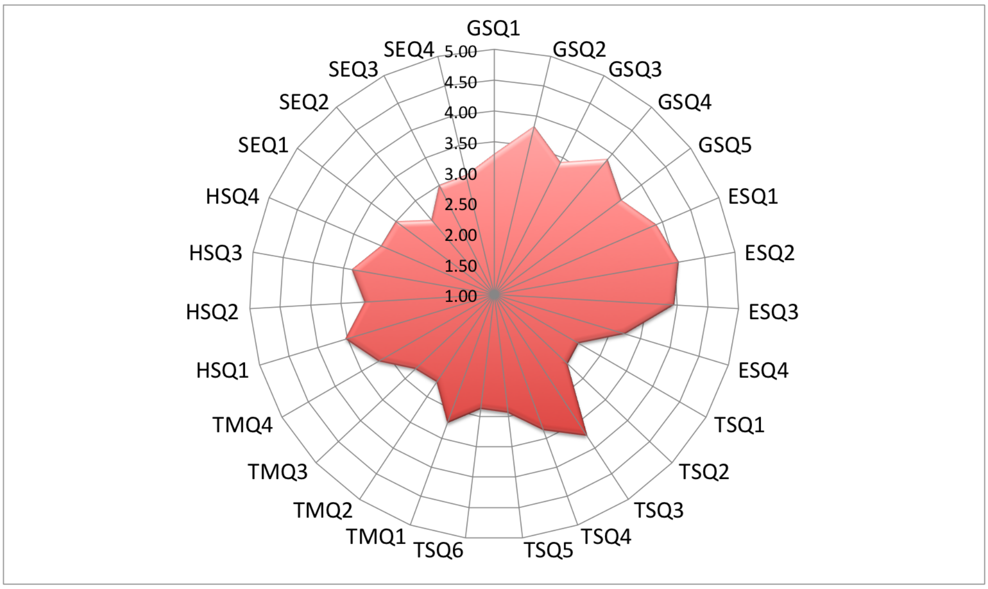

Figure 7.23: Visualisation of average SRL scores for the MOSLQ.

Table 7.7 shows the overall average scores of the MOSLQ grouped into six dimensions, with a visualisation of this result shown in Figure 7.24. These clearly show that the dimensions of greatest weakness are self-evaluation and time management. On the other hand, students demonstrated that they understand the need to set goals and to structure their environment, and they are focused on carrying out activities related to these dimensions. The students demonstrated reasonable goal setting skills and planned strategies towards achieving the desired results.

Table 7.7: Overall average score for each of the six dimensions.

Dimensions	**GS**	**TS**	**TM**	**ES**	**HS**	**SE**
Scores	3.60	3.03	2.97	3.78	3.25	2.90

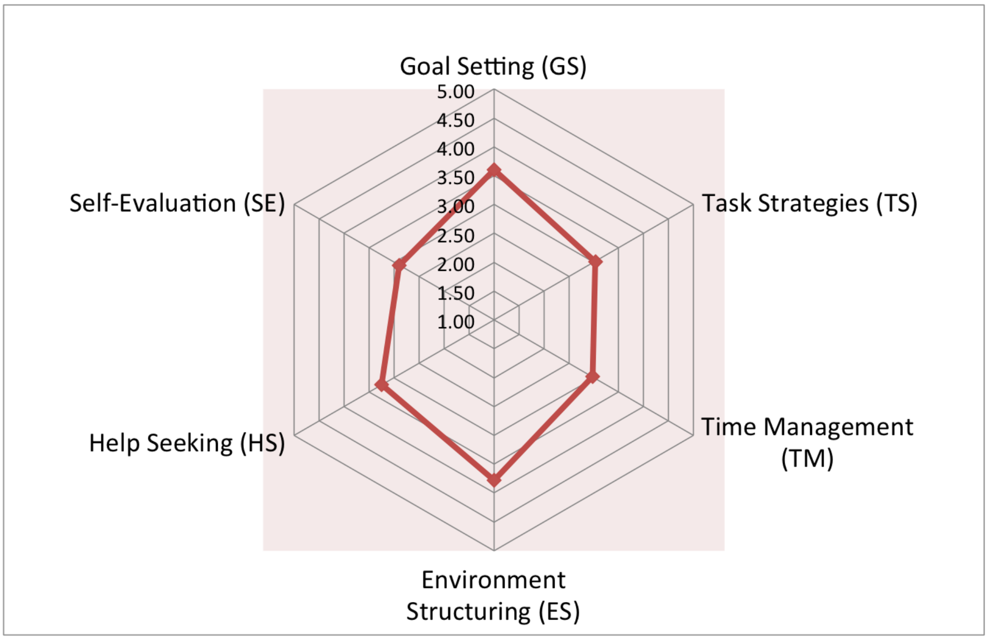

Figure 7.24: Visualisation of overall average SRL dimensions.

7.6.1 Results by individual students

Table 7.8 illustrates the average SRL scores for individual students. There is considerable variation between scores observed for different students ranging from a high score of 4.14 to the lowest score of 2.43. Most students have an average falling between 3 and 4. Further, there is notable discrepancy in specific dimensions between different students, as shown in Figures 7.25 and 7.26. For example, one student (Learner 12) claimed never to engage with any of the self-regulation activities relating to self-evaluation, hence scoring at the minimum possible level (1) on this dimension. In contrast, Learner 17 scored 4, indicating a high level of importance placed on reflection and self-evaluation. The most consistently high-scoring dimension across all students was the environment setting, demonstrating that students actively consider where and how they study best and take appropriate action to ensure a suitable work environment.

Table 7.8: Average SRL score for each student.

Learners	Average SRL Score
Learner 1	3.54
Learner 2	2.80
Learner 3	3.76
Learner 4	2.59
Learner 5	3.10
Learner 6	3.40
Learner 7	3.46
Learner 8	3.88
Learner 9	3.58
Learner 10	3.23
Learner 11	4.14
Learner 12	2.43
Learner 13	3.68
Learner 14	2.57
Learner 15	3.18
Learner 16	2.94
Learner 17	4.04

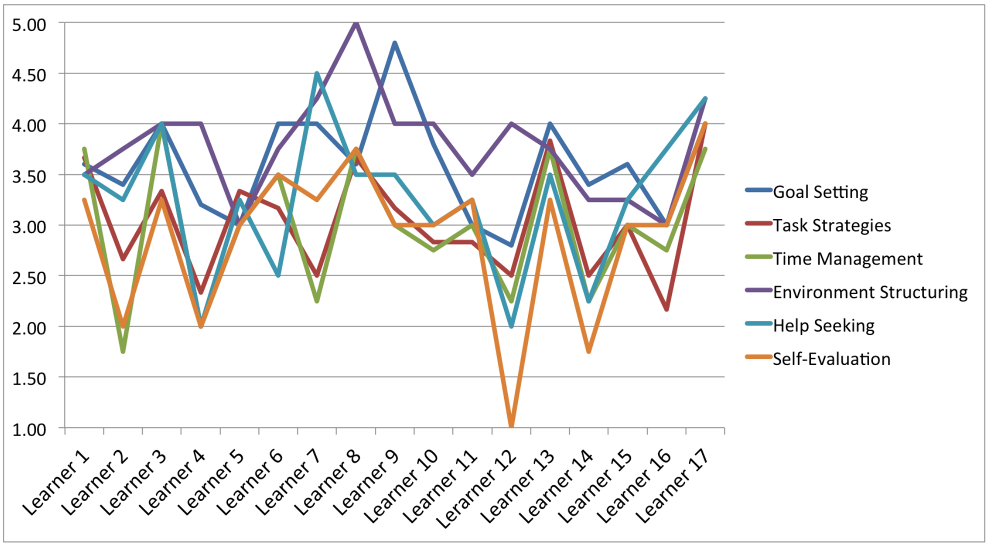

Figure 7.25: Individual student's SRL score with respect to the six dimensions.

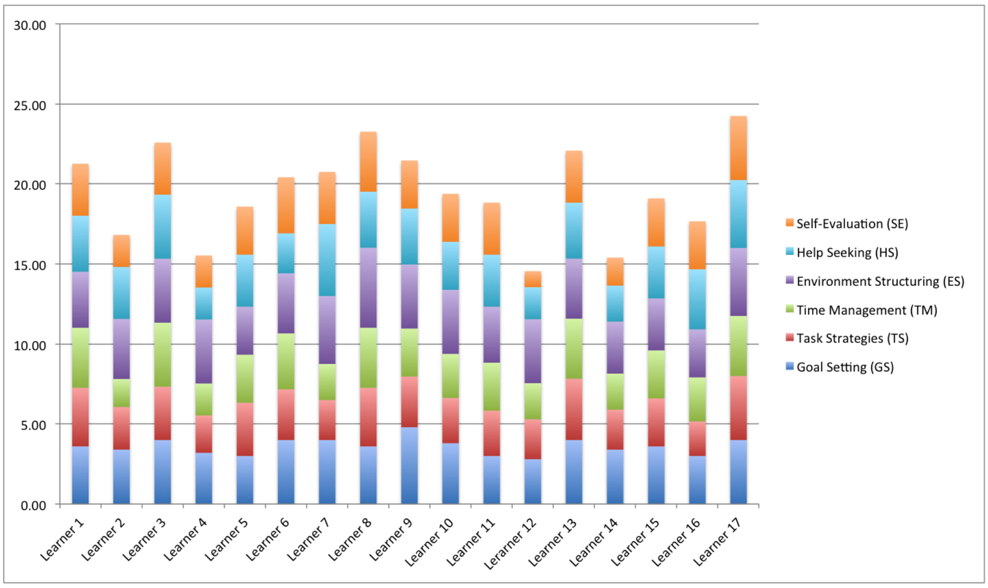

Figure 7.26: Another representation of individual student's SRL scores for the six dimensions.

These results clearly show the need for improvement in areas of time management, help seeking, and self-evaluation. This shows that students study effectively without considering time and prepare well to present a good quality assessment sheet. On the other hand, due to their lack the skills to frequently self-reflect or self-evaluate their learning activities, more interaction and an approach of seeking assistance should be incorporated within the learning pattern of the students. These three areas of SRL dimensions need to be reconsidered to determine how appropriate guidance could be provided to support students in making time management judgements and employing reflective practice in order to study effectively.

7.6.2 Average weekly assessment marks

Table 7.9 shows the students' individual average marks at the end of the term. The student with 17.13 marks did not submit the first assignment but scored over 20 marks on the rest of the weekly assessment. The overall average mark for all 22 students was 22.52.

Table 7.9: Average score for each student.

Students	Average Mark
Student 1	17.13
Student 2	21.88
Student 3	21.88
Student 4	22.38
Student 5	23.13
Student 6	24.50
Student 7	23.13
Student 8	21.63
Student 9	23.50
Student 10	23.63
Student 11	24.00
Student 12	22.50
Student 13	24.13
Student 14	23.63
Student 15	21.63
Student 16	22.38
Student 17	22.13
Student 18	21.13
Student 19	22.88
Student 20	22.75
Student 21	23.00
Student 22	22.63
Total Average	22.52

Table 7.10 shows the average mark obtained by this seminar group of students in each of the four weekly assessment tests incorporated in the module. The maximum mark obtainable was 25 in each case. The students were performing at or above the level that would be expected for this module. Even though SRL skills were low for some students in some dimensions, overall the students were obviously approaching and organising their studies in ways that worked for them and allowed them to perform reasonably well. It may be that, with greater focus on self-regulation and support for areas they are currently neglecting, their study could be improved further. However, it may also bring into question the appropriateness of

the SRL dimensions used and point to the need to rethink the conceptualisation of SRL for this context.

Table 7.10: Student average weekly assessment marks.

Mark 1	Mark 2	Mark 3	Mark 4	Average Mark
21.77	21.18	24.11	23.02	**22.52**

To further explore the SRL skills of the blended-learning students from a different perspective, this study conducted two focus group interviews to investigate individual student's learning strategies. Section 7.7 describes the focus group overview, the qualitative data collected, the analysis, and the various data interpretation approaches used in the study.

7.7 Focus Group : Overview

A focus group is a technique which involves the use of in-depth semi-structured group interviews, in which participants are selected using a purposive or convenience sampling of the total population. The group might be focused on a specific topic area for discussion. The research participants were selected because they have similar understanding of the topic area [56] and were within the same undergraduate programme [176]. They were also likely to be very relaxed and comfortable to talk within the selected group of students and the moderator. One very important feature of this focus group interview was the dynamic nature of the group discussion, which led to more effective communication in a relaxed atmosphere.

It has been observed that a focus group can expose information on a range of new ideas and feelings that the individual participants have about certain specific issues, and illuminate the different perspectives from individual participants [244]. The participants in this study have their individual different ways of learning. They devise methods to motivate themselves in learning and focusing on achieving their academic objectives. The results of this focus group also expose similar study patterns within the students. The researcher observed that the students share understanding of each question from the response of each respondent. That is, the discussion is further facilitated by the preceding respondent. A study argued that participants in a focus group were inspired by other respondents' responses to generate effective 'data based on the synergy of the group interaction' [130]. In addition to this, Krueger and Casey [176] point out that some individuals have the ability of self-disclosure and comfortable in discussing issues while others will need a level of confidence and trust to be able to disclose personal issues. The purpose of the focus group in this study was to promote self-disclosure amongst the associated student participants [175].

7.7.1 Respondents

The students participated in a focus group interview and responded to the questions (in Appendix G) during the discussion. To facilitate this focus group design, a convenience sampling approach was necessary to select the student participants for the research investigation [68]. The selected participants comprised three computer science students, four students of computer and business studies, one discrete mathematics student, and one computer science en-route to master student. The group consisted of eight males and one female. Table 7.11 illustrates the respondents for this focus group discussion. The participants' names are represented with pseudonyms, but other details, such as their gender and their programme of study, remains the same.

Table 7.11: Respondents, gender, and programme.

Pseudonym	**Gender**	**Programme**
Ben	M	Computer Science
Lucy	F	Computer & Business Studies
Phil	M	Computer & Business Studies
Joe	M	Computer Science
Jim	M	Discrete Mathematics
Chris	M	Computer & Business Studies
Kevin	M	Computer & Business studies
Andy	M	Computer Science MEng
Steve	M	Computer Science

7.7.2 Data collection process

A semi-structured interview format was used for the focus group discussion. The participants were divided into two groups and the question template was the same for both groups (as shown in Appendix G). The interview was recorded with three different devices: an iPhone, a recording device (recorder), and a MacBook with Audacity audio software installed. The advantage of using these three devices was that the researcher intended to be on the safe side to attain a relatively accurate record of the focus group sessions, and to avoid any issue in case of a fault with one of the devices. The other reason was that if a session was not clear because of low voices, interjected communication, laughter, and overlapping conversations, one could quickly listen to the sessions that require more clarification from the other devices. Also, if the memory of any of the devices ran out, the interview would continue with the other back-up devices, which all started recording at the same time.

7.7.3 Focus group analysis

Robson [252] pointed out that one of the central aims of focus group data analysis is to reduce the data into smaller chunks in order to conduct easy analysis. Data analysis consists of number of processes for example coding, categorising, classifying in order to address the study objectives. Yin [339] points out that 'data analysis consists of examining, categorising, tabulating, testing or otherwise recombining evidence, to produce empirical based findings' [339, p.132]. Corbin and Strauss [70] describe data analysis as an interplay between the data and how the analysis was done by the researcher. The use of both qualitative and quantitative methods in the focus group interpretation is to bring meaning to the data collected [244]. In another situation, to minimise the potential of bias in analysing and interpreting the focus group data, the analysis was conducted in a systematic, sequential, verifiable, and continuous manner [176, 174]. It is always important to note that regardless of the approach of either qualitative or quantitative methods used, there is always an element of subjectivity based on the researcher's objectives during the data analysis process.

This section reinforces the view of Krueger and Casey [176], namely, that smaller groups show greater potential for achieving more audible and useful voice data. The focus group interviews in this current study were conducted using two small groups. The first group had six participants, and the second had three participants. The researcher observed that richer data were extracted from the transcript of the group of three participants compared to the group of six. The transcript of the smaller group of three students could provide extensive and audible voice data from the students' perspectives in a more orderly manner, while in the other group of six students, some responses were not audible because of the overlapping conversation from other participants. In this study, much time was invested to contact students studying the same module to participate in the focus group interview sessions.

7.7.4 Methods of analysis

The process of thematic content analysis used in this study enabled the researcher to search for important emergent themes, which could be coded and categorised to describe the phenomenon of interest in the study [84]. The process was conducted in accordance with coding best practice and involved careful iterative reading of the transcribed text for identification of themes from the raw data [246]. In this process, emerging themes become the classified categories, which are then used for the data analysis. The analytical method selected for this study was the combination of content analysis and thematic analysis incorporated into an initial data-driven process using a deductive coding approach [75] and using an inductive coding approach [49].

The deductive approach to coding which identified themes based on the research questions or existing theory are used to provide the initial categories for coding. While in the inductive approach to coding allows themes to emerge from the data. In this current study, the deductive codes were derived from the six SRL dimensions, while the sub-themes were derived from the questions as presented in section 7.8. The coding involves reading the participants' responses one after the other and encoding relevant views prior to the effective interpretation of the data. A good code captures the richness of the phenomenon data during the analysis process [49]. During the encoding process, the data were classified and nodes were created that captured the initial coded themes from the raw data.

Following the data collection process from both focus groups, the transcript documents were entered into the NVivo application package for a more comprehensive data management process. This research used the NVivo software package to conduct the initial coding by manually selecting and coding relevant phenomena into the created nodes for a systematic identification of the initial themes. Classification of the participants was done in NVivo to capture the participants' demographics of gender, course, and preferred mode of study. For the preferred mode of study, the learners either identified with SDL, instructor-led learning, or the combination of both. This aspect of the students' mode of study is imperative to this research.

7.7.5 Data interpretation procedure

This chapter investigates blended-classroom students' individual SRL skills which may lead to better academic performance. The questions that gather data relating to the initial inductive themes were based on the research objectives. Recent literature reviews highlight the fact that there has been little research on the students' ability to develop unique SRL skills identifiable in their study patterns to support and motivate their learning to attain high academic performance in a blended-classroom context. Following the observation from the students' attributes which were exposed in the focus group discussions, there are some new emerging themes for exploration that were identified among the students which are as follows:

- The various patterns built from the General Certificate of Secondary Education (GCSE) and A-levels that improved their undergraduate studies;
- How learners were able to identify what works and what did not;
- How learners prioritised their time to meet deadlines;
- The criteria learners applied in setting goals to achieve;
- The modalities learners developed to strategise their tasks, such as assignments, and to prepare for assessment and exams;
- How learners prepared for their classes and revised after class;
- What, how, and why learners reflected on their studies using their weekly marks and practical exercises;
- How learners formulated their reading patterns using several props, such as music, games, and other activities to help their studies.

7.7.6 Coding process

The data analysis focused on deductive and inductive thematic and content analysis. In this study both qualitative and quantitative approaches were applied to the content analysis. The latter was used to analyse the word count and frequencies of the themes to demonstrate the level of emphasis on a pattern or patterns to illustrate both the differences and similarities in the views of the students. The counting of the number of words and number of different words, illustrated in content analysis, are both useful in analysing the raw data because they provide an indication to show the representation of the word content in the focus group transcript data. The content analysis approach is typically applied to the focus group data. At the very beginning, an initial coding was conducted to formulate coded themes in relation to the theoretical basis of SRL in this research. A colour-coded format was used as a framework guide to identify text related to different themes. The raw data were transcribed, then descriptive statements were created in form of the initial coding. Then themes which emerged were coded as focused-order coding and translated to final-order coding, which was later interpreted and documented as shown in Figure 7.27.

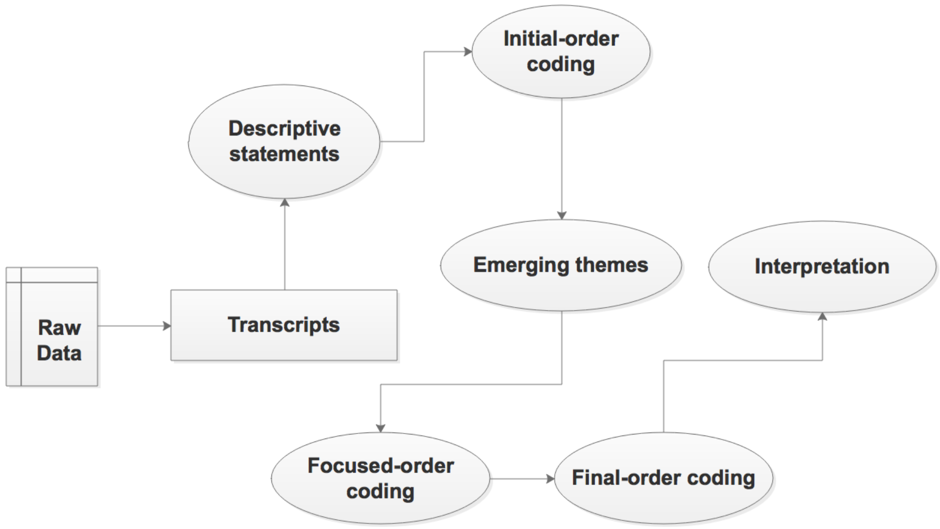

Figure 7.27: Focus group data interpretation approach.

At the initial coding phase, the following steps were conducted: firstly, familiarisation with the data by listening to the recorded interviews, secondly, reading through the transcript analysis, and various stages of coding that generated themes and interpretation, and finally, classification and categorisation of the emerging themes and sub-themes as shown in Table 7.12. This initial stage coding helped to group different opinions recorded within the focus group interviews. The data were processed to gather evidence of the phenomena and new views that have emerged from each theme. This procedure enabled the researcher to find and count the numbers of occurrences of the various themes discovered in the transcripts [292, 198]. The researcher listened to the audio interviews, transcribed the data and read through the transcript text constantly. During this process, themes started emerging which were noted for further exploration. The following stage was to identify a proper thematic analysis framework by identifying and writing down short phrases from the transcript text, ideas or concepts appearing from the text which then led to creating categories. At this phase, descriptive statements were developed which formed the initial coding before further coding interpretation (as seen in Table 7.12).

Table 7.12: Processes of coding the focus group data.

Coding phases	**Coding steps**
Familiarisation of audio recordings.	Listening to the recorded audio interview data in order to get familiarised with the research participants' voices.
Transcribing.	Transcribed the focus group data from the audio interview, preparing and formatting the transcripts for coding.
Initial-order coding.	Using NVivo software package to code the transcript, creating initial categories and classifications.
Focused-order coding.	At this stage, the transcript was coded for each research participant separately, and gathered initial themes and sub-themes.
Final-order coding.	The final-order coding was based on the further classification and categorisation of emerging themes from the focused-order coding which generated inductive themes. The deductive themes were based on the six SRL dimensions and the deductive sub-themes emerges from the the focus group questions.

There are several methods applied to interpret focus group data. Schutz [270] assumed a logical consistency that is related to the description by Horsfall et al. [146], which involves in-depth careful analysis of the phenomenon in the study to produce meaningful results from the data. The phases of the analysis in the current study were conducted with transparency and openness to formulate the overarching themes from the data [107]. Schutz's second assumption of the data interpretation was to obtain the participants' opinions to acquire acknowledge of the context on which the research was based [270, 271, 146, 181].

The views and reflections of the participants captured from the voice data were transcribed and analysed, and they illustrated the findings from the data interpretations revealing the credibility of this study. The stages of the data analysis outlined how the themes emerge from the coded data, which ensured the generated overarching themes were linked to the participant's raw data interpreted in the study. The research interpretation was based on the participants' responses to new ideas or phenomena that emphasised vital points [262].

7.7.7 Principle of the procedure and classification

This study started by gathering the data in chunks or pieces according to the research interest. This process led to the individual codes or categories that were created. The participant's transcript content was separated in accordance with each of their conversations. The framework proposed for this focus analysis incorporated the following procedures:

- The researcher created a document for each participant and saved their conversation in the file;
- The researcher read the transcript thoroughly to make ensure each saved document contained only the participant's responses;
- The researcher then coded each of the participant transcripts separately to identify individual themes from the coded data;
- During the coding process, the researcher noted key areas and phenomena of interest in the research diary. This activity helped the researcher to query and identify specific word frequency, similar opinions in agreement, and different contrasting views.

The idea behind doing this separation was to create codes that are based on individual respondents' views. The framework proposed is to reflect individual points and investigate common or related attributes of their opinions. This process was done to suit the gathering of the data into the six SRL dimensions of this study on which the research is based. With these deductive SRL dimensions arranged sequentially as needed, the systematic and comprehensive data analysis begins with identification of key themes within the distinctive raw data.

7.8 Deductive Themes

In conducting the focus group analysis, a few questions that were extremely relevant for this study within the six SRL dimensions were selected and reported. The deductive themes in this analysis are represented by the six SRL dimensions. The sub-themes in each of the dimensions are emerging themes from the questions. In each of the dimensions, frequent features were observed within the discussion which were represented using a word cloud. Some of the attributes which were prominent for example, ‘like’ and ‘work’ are features that were commonly used in the discussion. This section presents further percentage analysis of important themes that emerged within the discussion in each of the dimensions.

Goal Setting

Could you tell me how you have prepared for your studies?
Sub-theme: *Preparation for studies.*

The learners prepare themselves in various ways. Ben prepares for his studies by collecting several relevant learning resources. This student said he does several mental preparations before engaging in his studies. Because he must study a lot, he usually looks for things that will motivate him to put him in the preparation mode. For Lucy, she tried to put herself into the state of mind for studying; this was done a couple of hours before reading. Phil was the opposite of the first two, preferring to leave his studying until the last minute. He knows he should get it all done when the need arises, and as he studies, he reviews his progress. Joe prepares by just focusing on the given task to make sure he achieves his goals. For Jim, he usually starts off by clearing everything off his desk that he does not need. Jim arranges his study materials according to topics that he wants to study. For Chris, he prepares for his studies by collecting all the past examination questions and then tries to group all possible questions that could be asked in the examination. He developed this habit to help him compare the lectures with the questions to explore possible areas most likely to be on the examination. This helps Chris to narrow or prioritise his reading to areas that matter to him, and he ignores any activities that are not directly applicable or do not explain the questions. For Kevin, he continues a task for a long time until he achieves the results. Much of his effort is placed on modules with higher credit units, so that he can perform well to attain better grades. Andy said he prepares to read the lecture notes after class, and when he finds something that he is not fully sure of, he explores the topic further to gain more understanding. Steve, on the other hand, goes to the library after the lectures and studies more on areas of concern. He said he will continue to read on an area he is having problems with until he understands and does not forget it. This dimension reveals the desired goal of the students, which is centred on attaining success and graduating with good grades.

Figure 7.28 illustrates the common words used during the focus group interviews during the goal setting session.

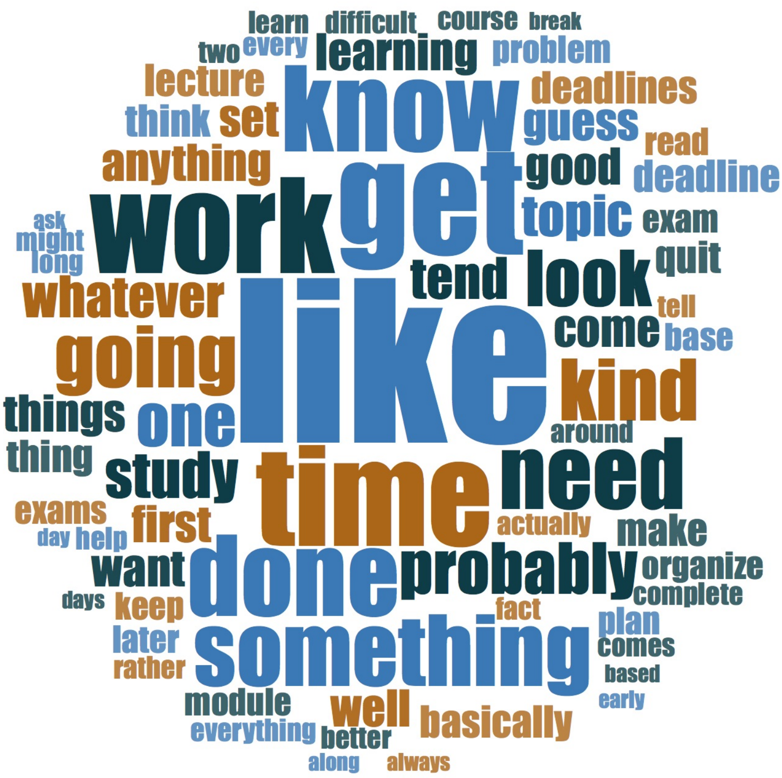

Figure 7.28: Visualising common words used in goal setting sessions using a word cloud.

Figure 7.29 demonstrates common terminologies used during the goal setting session of this focus group discussion. Many of the students (about 40%) said they set up their goals based on interest and to gain adequate learning experience. The students believed they are motivated to study when a module is interesting and when they are interested in the topics. About a third (34%) of the learners mentioned that they organised their goals based on modules with the nearest deadlines and to understand their subjects. Finally, fewer than 26% said they set their goals based on motivation and results.

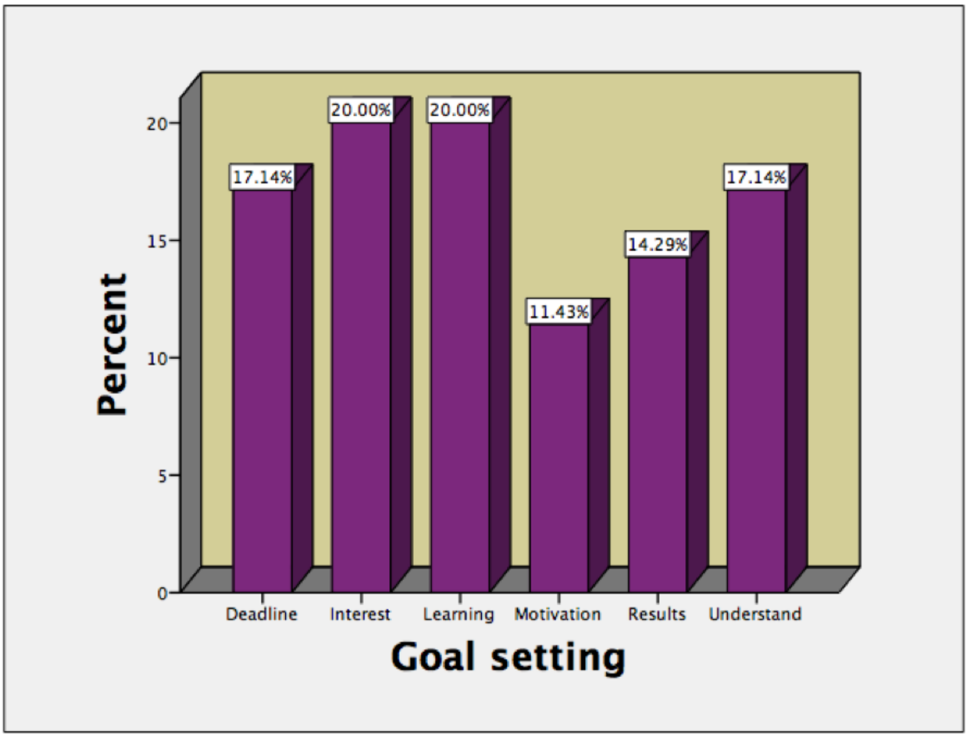

Figure 7.29: Percentage of important themes in goal setting session.

Task Strategies

Could you tell me what strategies you used in engaging with your studies?
Sub-theme: *Strategies used in studies.*

Ben starts with the hardest modules first to get them out of the way and then follows with the easier ones. Ben mentioned that he tackles his assignment task by trying to understand the questions before working on them. He tends to discuss the tasks with friends that have completed the tasks. For Lucy, whenever she has multiple assignments, she stays focused on one topic at a time and then works in smaller bits. She tries to finish her current task before starting new ones. Phil said that, when it is not the exam period, like Chris, he also has an Excel sheet in his head that helps him know when deadlines are near. He said, *'I know when and what I need to get done'*. However, during examination time, Phil makes a timetable close to his exam timetable to help him determine how much he needs to cover in each module. If Phil is interested in a module, he attends every lecture and takes notes as well. He said he will also properly do one essay first, then move to the next to keep him motivated throughout his study period. Phil said *'I know I can get it done it's just a matter of keeping myself motivated throughout the process'.* This is how he structures his reading strategies, so that he can assigned more time to modules that he likes. Joe, like Phil, chooses modules that are most interesting to him. Joe has a unique way of studying, by playing his Xbox game system when he is home. Joe strategises his reading by forcing himself to do his work for the rest of the day whenever he loses a game. Joe also studies better when he spreads papers he used to practice his exercises on all over his desk. He judges his reading capacity by the number of papers he has on his desk. Joe finishes his tasks early and leaves them for a while and then reads them again when it comes to the deadlines so he can refresh his memory. This style of study is unique to Joe and new to the rest of the participants.

For Jim, he sets aside each day to go over a topic without planning how exactly he will do this. In the case of Chris, he tends to do the harder modules first; however, in his recent study strategies, he has decided to do the easiest modules first. Chris said the idea of doing the harder modules first, just like other respondents, makes him do the easier ones more easily. Chris, on the other hand, takes an unusual approach to his studies. He likes to use an Excel sheet to document his hours of study every week and then breaks those down into everyday by getting some tasks done daily. For Kevin, he tries to teach the topics to his friends and sets a time slot to do his work. He also divides his tasks into sections and focuses on a section to study. Andy said he plans to explore the given task well enough before answering or solving the given problems. Steve said that he works better under pressure. If there is the pressure of a deadline, then he must work hard to present a good assignment and devote his time fully towards the given task to complete it successfully.

This dimension indicates that the students place a lot of effort into making sure they know what to plan, what different strategies to apply in tackling their tasks, in studying, and during the assessments. Lucy mentioned that she writes notes and reflects on them. She developed a strategy of rewriting her notes and then she continues doing the same thing repeatedly; that is how she learns. Phil, on the other hand, said that if he is making a note for a module, he just concentrates and makes notes. Joe shows similarity in his study patterns to Lucy by also rewriting his notes. Joe incorporates his penchant for computer video games into his study style. He plays on his Xbox all the time, and when he loses, he plunges into writing his lecture notes continuously. He said *'I basically played every day, which means I basically study every day'.* This means he studies every day by rewriting his notes.

In the case of Jim, if he does not understand a problem, he looks it up, be it questions or topics, and he tries to write everything that he can remember about them, stating, *'If there is something that I know I can't quite understand the definition of a term or something then I go back to my note and look for it and I will write it out again'.* Chris, on the other hand, tends to draw out his notes. He draws a set of diagrams to illustrate and explain the module better to him, stating, *'I mean it is much easier to remember things visually than just doing notes'.* He applies the strategy of drawing his lecture notes rather than rewriting them, like Lucy and Joe. Chris also has developed the culture of teaching the course to his classmates and discussing what he has read randomly to friends around him. He said this pattern of discussing what he has read with friends helps cement the information in his head. He stated *'I think reading the key thing so far has been like drawing out the notes because that makes it personal that also makes it much easier to remember'.*

Figure 7.30 illustrates common words used during the focus group interviews in the task strategy session.

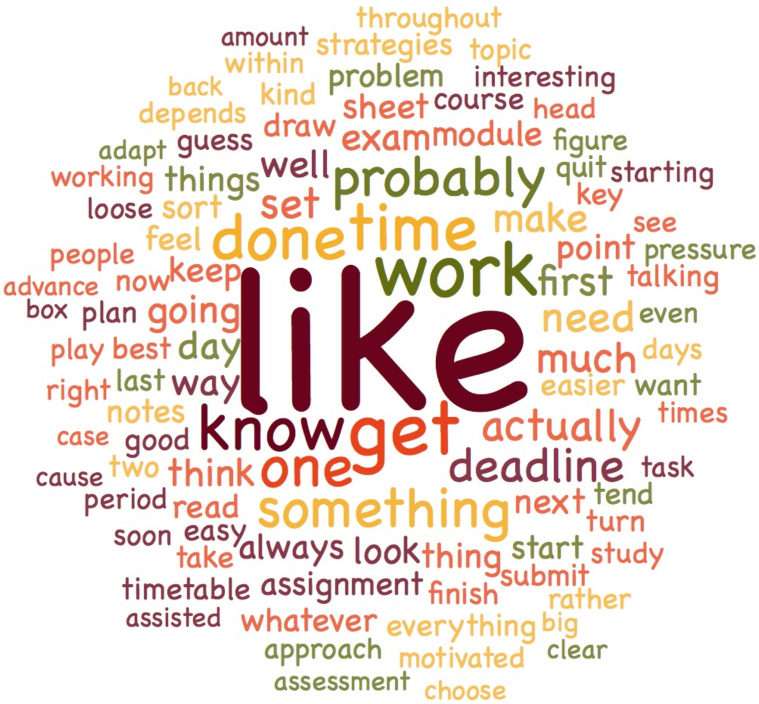

Figure 7.30: Visualising common words used in task strategy sessions using a word cloud.

Figure 7.31 shows that 21.88% of the students said they planned their task effectively by reading. This process helps them understand the strategies used while organising the task. Fewer than 19% of the students agreed that they strategise their studies effectively by listening to music and planning their preparation.

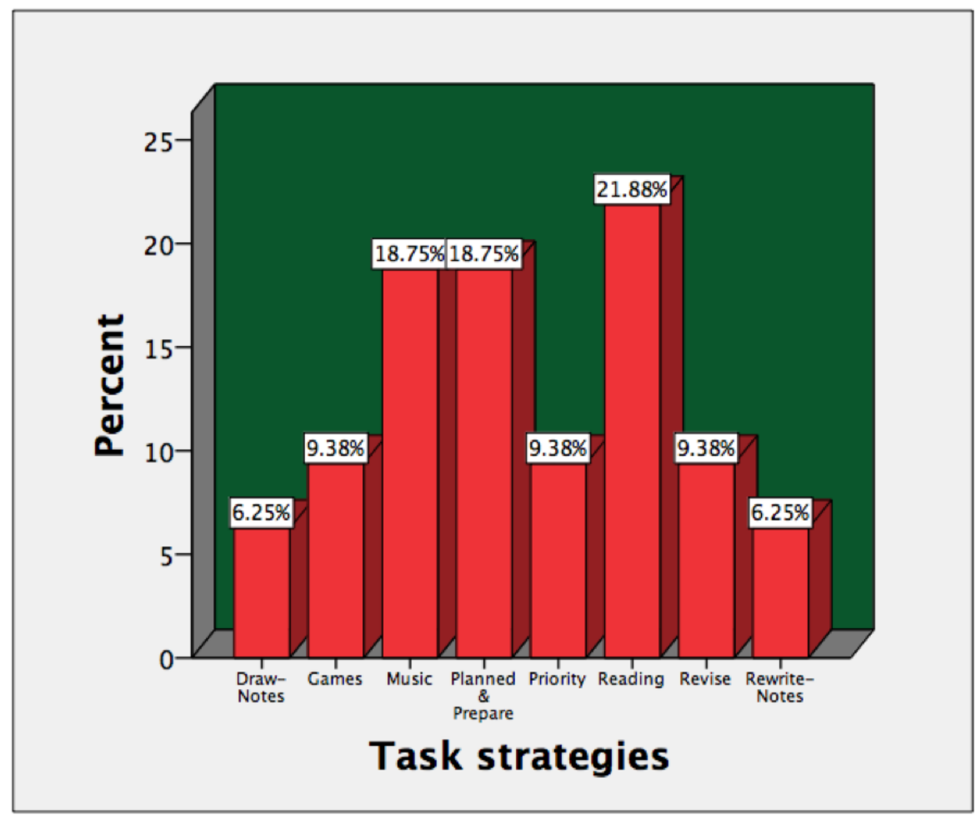

Figure 7.31: Percentage of important themes in the task strategies session.

Time Management

What influences your decision in allocating the time for your study? Could you share with me how you decide the various times?
Sub-theme: *Allocating time for studies.*

In response to the question, Ben said that he spent more time on things that are harder because this pattern of study helps his brain. His major challenge is that he does not know when to complete his task. He might start a task and finish it on the same day. He said that this depends on his other activities. In Lucy's case, she dislikes leaving her tasks to the last minute, so she tends to get rid of modules that she does not like. If she has an assignment due, she just concentrates and does it earlier, and then she reflects on it until the submission date. This is another attribute of self-evaluation skills, namely, to reflect on her work until she submits it, which will provide room for further re-evaluation and correction of the assignment to present much better work. Phil is very conscious of deadlines, so if he gets his assignment and it is getting close to the examination period, he quickly starts as soon as possible to avoid missing the deadline. He still maintains his approach to working in smaller bits, and he usually ends up doing a lot of things before the deadline. Phil sometimes prioritises his work when an expected event happens, and this helps him to remain focused on doing just one task after the other. Joe tries to complete all his work as quickly as possible, so that he does not have to think about it and can have time to relax early. Jim does not tend to manage his time very much; this means that when he has a lot of assignments to do, he resolves the tasks as soon as they are given. Chris usually sets up his plans using an Excel sheet. He dedicates a model for his course and each subject. He says he sets four or five hours which he divides equally between two modules. If he finds out that he cannot complete anything within the most difficult module out of the two, he said *'I would not spend much time trying to understand it; I will just say OK that is the two hours done'* until the next two hours before he tries to understand the module again.

Kevin said that if he is interested in a module, he reads more about it. Additionally, if he is studying a module that he is interested in, then he tends to spend more time on those in which he is interested. Kevin said that this process allows him to organise his modules with all his activities by priority in sequential order. Andy mentioned that it was very difficult to organise his study time and that it is not something for which he is familiar with during his studies. He claimed that all his studies were done using his instinct. However, the distinctive pattern of reading and exploring in advance, as exhibited by this student in tackling the task, is unique in the sense that he waits until two nights before solving the problems and then submits them. Steve performs his tasks in the order in which the deadlines occur in a sequential order. In a similar manner to the other respondents, the priority of the module deadline takes precedence over the setting of a revision time table. In the student's own words, *'In order of which deadline occurs is when I do it so whatever is first I will do that first and then I will just go through it that way and I will do it until I understand at first then I will move on'*. This behaviour could be attributed to a proactive ability by the student to ensure he effectively masters the module and content before proceeding to another.

Figure 7.32 illustrates some of the common words used during the focus group interviews regarding the questions in the time management session.

Figure 7.32: Visualising common words used in time management sessions using a word cloud.

Of the students in the focus group, about 30% agreed that when they are under pressure, they tend to manage their time effectively to meet deadlines. In this case, they work based on modules with the nearest deadlines. About 60% of the students said that, when a module is important to their degree, they prioritise their reading first in terms of those topics that are important to them, as seen in Figure 7.33.

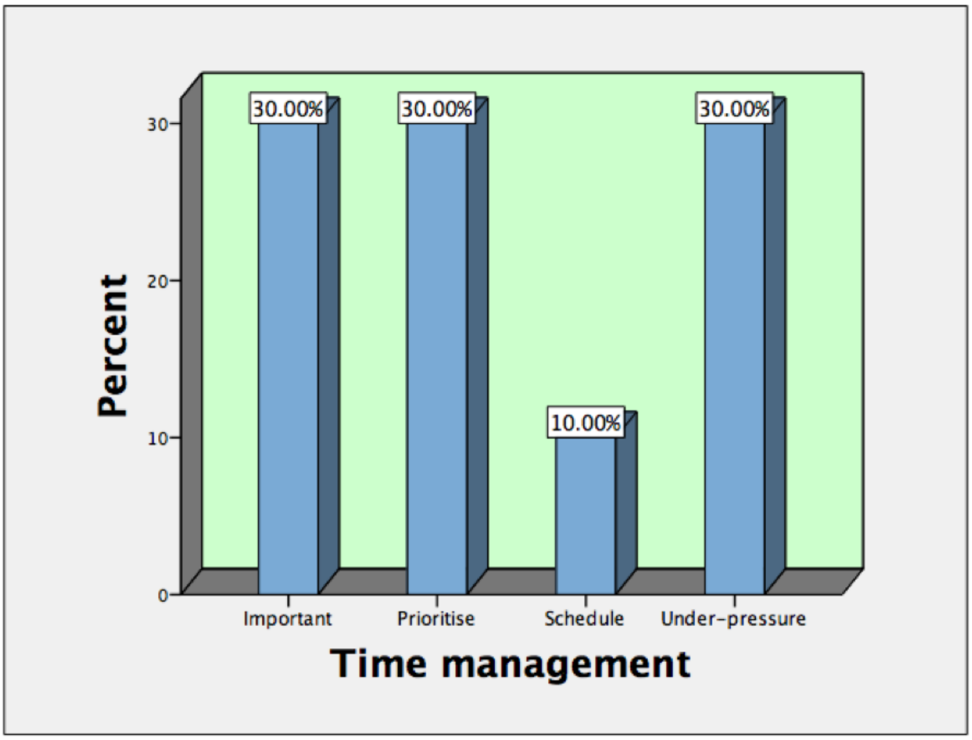

Figure 7.33: Percentage of important themes in the time management session.

Environment Structuring

How do you feel when you choose an environment to study? Can you discuss your preferred learning environment?
Sub-theme: *Preferred learning environment.*

Ben prefers to focus on one subject, and he immerses himself into it to acquire the full understanding of the topics. He is not the type that tidies up his reading environment before studying. He prefers his resources to be around him always so that he can easily and quickly reach whatever he wants. This has helped him do his work properly. In contrast to Ben, Lucy prefers her reading area to be tidy before she can commence her study. She has the belief that if she tidies her desk, then she knows she must study because tidiness has placed her in a state of mind to study. Phil mentioned that, in his case, he needs music to work. He listens to music virtually all the time as much as he can, especially during study to help him ignore all the distractions from other people. He, on the other hand, like Ben, does not care whether his environment is tidy or not. For Joe, he can work anywhere and does not need a quiet environment. He prefers working with several blank sheets of paper and tends to be satisfied and stop working when he sees that he has so many sheets around him. Jim, on the other hand, prefers to study alone; he cannot study around people because he easily gets distracted. Therefore, his mindset is to remove any form of distraction. Apart from that, he also agreed that he prefers to study in a tidy environment. Chris prefers a completely silent environment during his studies. In contrast to some of the students, Chris cannot study effectively with music in the background.

Kevin said he prefers a quiet environment to study. He takes the initiative to go to the library to study if he wants to get something done. Studying in a quiet environment makes him concentrate on his studies. For Andy, he said it depends on the task at hand. Music is always important to him while studying, especially if it is a programming task. He prefers to be around people who are working on the same task to avoid getting lost or confused on the assignment. A very interesting discovery is that this student mentioned that he also does all his work on voice chat with friends. This was a new finding for which the researcher wished to recommend in the online MOOC version of this study. Steve, on the other hand, mentioned that sometimes he just isolates himself in his room with some background music playing while focusing on his studies or on what needs to be done. On other occasions, Steve said he has studied with people around to obtain support from friends in case he needed any help while studying. The student claimed he tried to balance these patterns of studying based on the difficulty of the module. Most of the students chose a comfortable environment to study because they wanted to remain focused and complete their work properly and to understand specific subjects in which they were struggling.

Figure 7.34 illustrates the common words used during the focus group interview in the environment structuring session within the two focus group interviews.

Figure 7.34: Visualising common words in environment structuring sessions using a word cloud.

Figure 7.35 demonstrates that over 30% of students in the focus group session prefer to study in an environment with people. They study this way because they want to be able to share ideas and ask for help with difficult subjects. This habit of studying with other people is also an attribute of help seeking skills. Over 26% of the students said they prefer an environment where they can stay focused and study. About a third or under 35% of the students said they prefer their learning environment to be tidy, silent, and with few distractions.

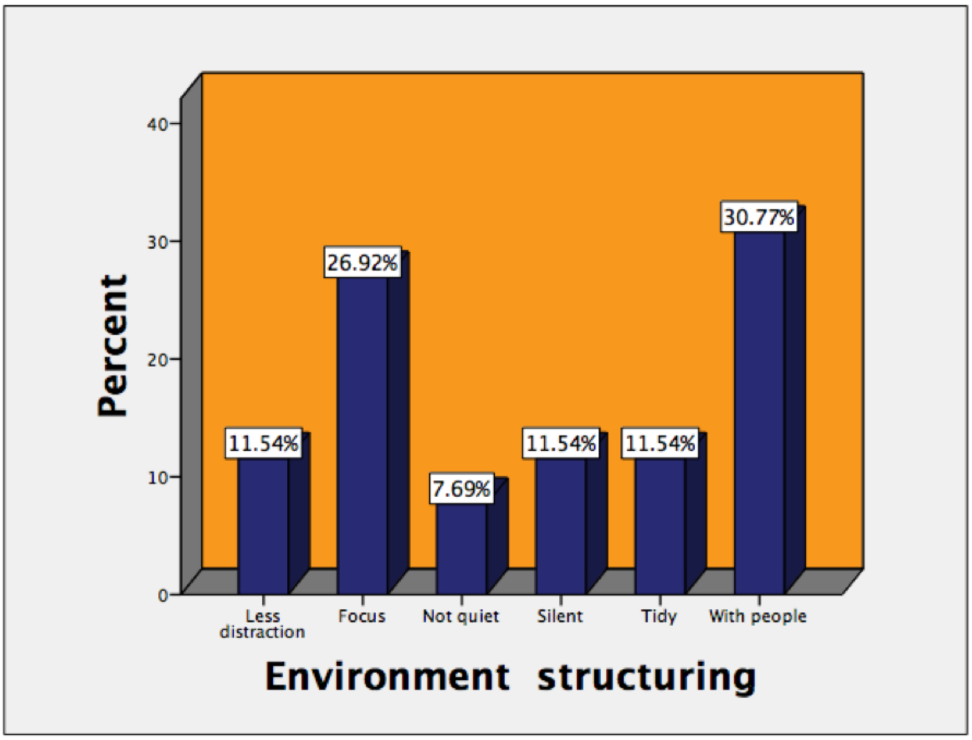

Figure 7.35: Percentage of important themes in the environment structuring session.

Help Seeking

In what ways do you seek help with your studies? Please tell me how you have done this.
Sub-theme: *Ways of seeking help*

Ben said he did not often seek help from people; occasionally, he asks friends and sometimes spends days on YouTube channels. Ben sometimes prefers to see people working on the assignment questions and afterwards, he becomes motivated and progresses to do it by himself. He generally makes use of YouTube and the Internet in helping him comprehend what he does not understand. Lucy prefers to seek help from her course mates and other advanced year students. Phil, on the other hand, usually just tries to attempt the questions. He asks other people who have done the questions and looks at what they have done to help him realise where he is going wrong whenever he needs help. Joe tends to ask people as a last resort. Like Phil, Joe will first experiment on everything. When he finds out that he cannot discover the solution to a problem, he then asks course mates or uses the

Internet. Joe considers all his options before seeking help in most of his modules. Seeking help early is essential to studying effectively, just as in the case of Lucy asking friends and Phil observing course mates that have solved the problem. This helps the students to acquire a full understanding of how to solve the task.

Jim on the other hand works as hard as he can at the very beginning and later seeks help from course mates as well. Jim claimed that they all knew each other's strengths and those who are 'good at what'. This skill of recognising the skills of course mates and who could be of help to a student while studying could help the students obtain adequate assistance on time. This could help foster self-regulatory skills that could help the student to build strong communication and help seek skills to support their learning. Like Ben, Chris also seeks help primarily from YouTube. He said he probably should have made use of lectures and goes there often and uses the opportunity of the tutor office open hours to seek help with his modules. For Kevin, he said that, if the module involves practical exercises, he prefers to study around classmates doing the same activities and discuss the tasks directly with them. This helps him attain some ideas about the task at hand and facilitates more enlightenment when he carries out further research. He seeks help during studies by asking friends that have done the task, emailing the tutor with specific questions, researching the subject using Google, and finally, using textbooks that can be easily referenced. Andy is like Kevin in that he also seeks help using Google. He prefers discussing with people who have not done the given task. The student claimed it was rewarding to work out the task together and that it would lead to better understanding rather than asking for help from someone who has already done it. Therefore, the student preferred to strategise and work on the task that could lead to a solution as opposed to asking friends who have done it for the answers. Steve seeks help from friends, Google, and lecture notes, like the other students in this study

Figure 7.36 demonstrates some of the common words used during the help seeking session of the focus group interviews.

Figure 7.36: Visualising common words used in sessions on help seeking using a word cloud.

Many of the students, over 33% in the focus group discussion, sought help mostly from the Internet while learning online. The other popular means of seeking help was study groups. Over 22% said they seek assistance from their study group mates, while under 15% agreed to ask friends for support in their studies, as seen in Figure 7.37.

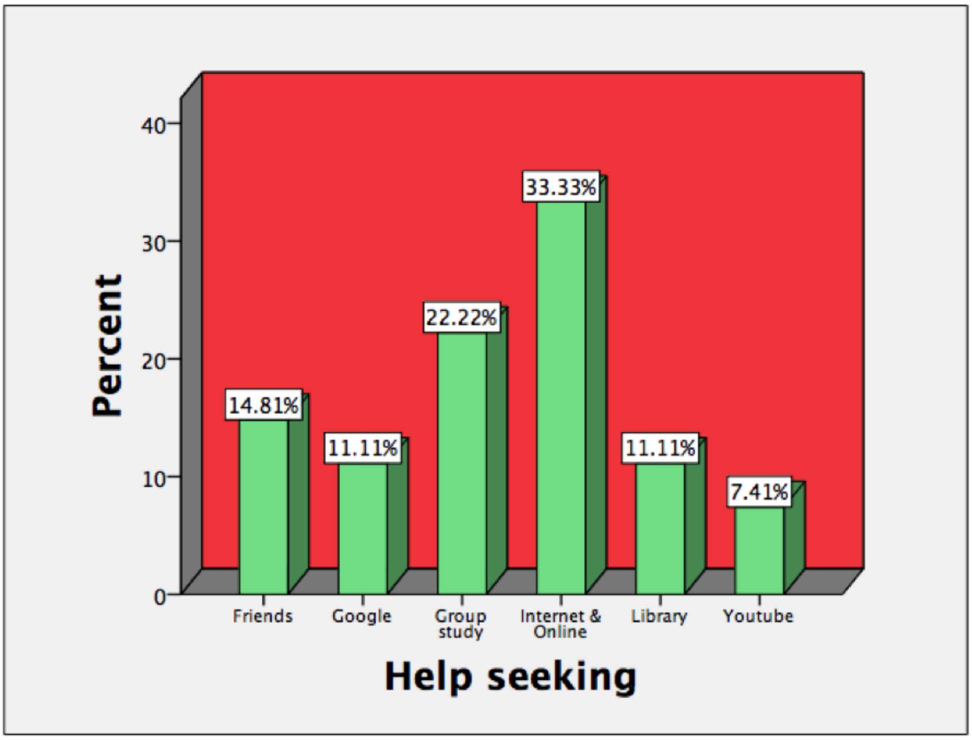

Figure 7.37: Percentage of important themes in the session on help seeking.

Self-Evaluation

Could you tell me in what ways have you reflected on your studies? On what occasions have you done this and why?
Sub-theme: *Self-reflection during studies*

Ben reflects on his studies as soon as he discovers that he has read and covered so many of his modules. Ben tends to reflect on how and when to evaluate, what he chooses to work on, and what kind of interest he has in his modules. For Lucy, if she observes the pattern of her studies is not working to her benefit she *'will end up trying something else'*. Phil digressed a little to his A-level days, as he reflected on what happened and what went wrong during that period. He said *'I need to have a look at it like what went wrong in time'*. He said his reading pattern during his A-levels was the same pattern as for his GCSE. While he was successful for his GCSE, he was not successful in using the same reading pattern for his A-levels. He now realises that there was a 'big chunk' so that is why he could not apply the same kind of study methods he used during his GCSE for his A-levels. He had started looking for other ways of motivating himself in his studies. This is the reason he developed a pattern of studying by listening to music. He then applied the method to motivate himself during his A-level studies. This seems to be effective, so that is why he remained with the approach till now.

Like Phil, Joe also had the same experience. He too was inspired by Phil's issue with his A-levels to say he had similar problems. He had to re-evaluate his study patterns after he was not successful with his A-level examinations. Joe's case was peculiar, in that he likes playing video games, and he then reflected that he could use the video games to his advantage. He said *'I had played too much games but I found that I can, like, use it to my advantage'*, so he incorporated a method where he could enjoy playing his video games and get his studies done. Jim, in contrast, said he could not trust himself to evaluate his studies. Thus, in his case, he waits until he receives his assessment and then observes the exact area he went wrong and the sort of things that might have led to him making that mistake, and he tries to make up for or correct those faults or errors. He said he does not just start a task, but he thinks about it a little while, and then sits down and does it because he already has a bit of an idea of how to begin the task. This pattern helps him to tackle his assignment and overcome any hurdles. This was a brilliant way of self-regulating reading habits by researching a given task and strategising patterns to answer the questions and engage after fully understanding the requirements of the work. Chris studies and reflects on past examination questions. He said, *'So by the time the actual exam comes along I have, like, know the ideal condition so, like, do well'*. This student believed in putting himself in an examination condition by practising and reflecting on past questions. He said, *'this habit could help him to be confident and perform well during the real examination'*. In response to the question on how he reflected on his studies, Kevin said he reflects when revising, when assessment grades have been received, and when reading other topics over again. He said *'When I get a grade or predict a grade I guess that will help me to look back and see what's going on well or has not'*.

Like Kevin, Andy reflects on his marks per course work and then reviews where he has lost some marks. The student then reflects on whether it is something that was known to be wrong or whether he did not know how to approach the task before submission. For Steve, he is distinct in his reflection during studies. He developed a unique style of mid-term reflection throughout the academic year, which he said was the only period that he reflects on during his studies. This student also reflects when final course grades are received. Like the other students, Steve reflects on areas where he went wrong. This student also agreed that he reflects between his studies as well. This according to some theory of reflective practice that involved inward examination of understanding of ones study from the foundation could lead to effective learning [161, 266, 265].

Commonly used words during this self-evaluation session of the focus group interviews are illustrated in Figure 7.38.

Figure 7.38: Visualising common words used in self-evaluation sessions using a word cloud.

Figure 7.39 shows that some students (over 28%) self-evaluate themselves when they received their assessment scores. Fewer than 18% of the students mentioned that they tend to reflect on their achievement when the results from their examinations are released and when they see their final grades. Many of the students, about 42.87%, said that they self-evaluate themselves while listening, reflecting, and revising their lectures notes.

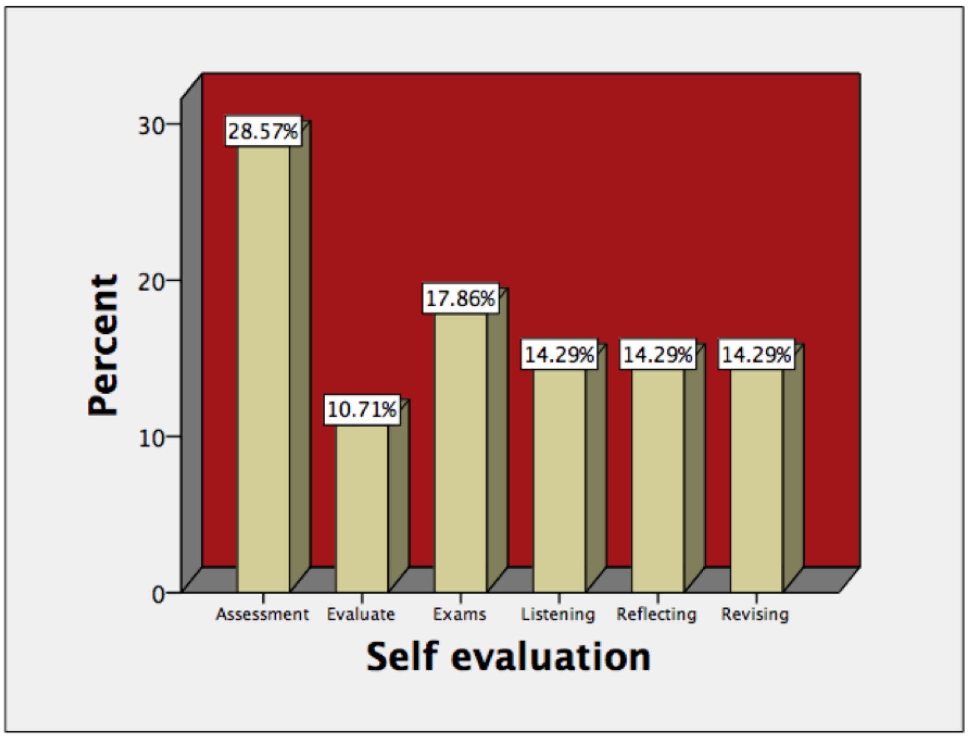

Figure 7.39: Percentage of important themes in self-evaluation session.

In summary, the general themes emerging from the six dimensions during the focus group interview sessions are illustrated in Figure 7.40 to show the most commonly used words throughout the discussion.

Figure 7.40: Visualising most common words used during the focus group discussion in a word cloud.

7.8.1 Study mode

How do you prefer to study? Explain to me if you wish to be guided in an instructional way or if you prefer self-study mode.
Sub-theme: *Choosing a study mode.*

Ben said that he prefers self-study mode. He tried studying once with friends, and it did not work out too well. When he was asked whether he needed anybody to instruct or guide him while studying, he said this could help him, but he did not feel he wanted to because he wished to do his reading by himself. However, Ben said he liked independent learning, and most of the time, he likes to go to lectures and learn something. Therefore, he prefers both ways of learning. For Lucy, she said she prefers studying by herself to understand, first, and if she struggles she goes for help in a group study. When she was prompted as to whether she benefitted from the instructional method of study as well, she said yes, meaning she also preferred both modes of study. For Phil, he prefers independent study; he said he likes trying to get his work done by himself. He does not like structuring his studies and really does not like people telling him what to do. He prefers to complete his work at his own pace and time. Joe said he prefers both as well; he likes to learn in an instructional way because he feels he can acquire more information than from just an application. He said he likes the moment when someone teaches him, compared to learning by himself. Jim also prefers both modes of learning, in his own case, if someone tells him what it is that he needs to know, he just makes sure he notes this, rather than trying to learn everything by himself. Chris, just like the others, prefers a structured manner of learning, primarily because he said it is just less time-consuming. Chris said structured learning helps him focus on the aspects that matter with the best resources. He gave an example of participating in an online course in Khan Academy. He likes the fact that he could visualise the video and comment on it and interact with the participants by asking questions and quickly get a reply. Chris said that, in his case, focusing on what is important is the best form of learning.

In terms of modes of study, Table 7.13 shows the mode preference of the learners. This reveals that the students in this study prefer to direct their studies and are also comfortable with instructor-led modes. The results, as extracted from the coded data, indicate that 71.4% preferred self-directed and both modes of study, while 28.6% preferred to be guided sometimes.

Table 7.13: Study mode preference.

Study Mode Preference	**Self-directed**	**Instructor-led**	**Both**
I preferred to study in ... mode(s)	35.70%	28.60%	35.70%

7.9 Inductive Themes

7.9.1 Description of key identified themes

These key themes were excerpts identified from the focus group transcript, which was coded in three layers: initial-order coding, focused-order coding, and final-order coding. These are top students in the class, describing how they study and what motivates their efforts in studying hard to meet deadlines and achieve better academic grades. The researcher observed how students built their personal SRL skills from distinctive activities and how they made them fit into their academic study. These themes are further classified into two main categories; (1) Motivation to learn and (2) Strategy used to learn, as illustrated in Figure 7.41.

Figure 7.41: Visualisation of the classification of emerging themes.

7.9.2 Motivation

Code definition: Indicator #1: Deadline

Several of the participants desired to meet deadlines in their modules. Some of the students just relax and procrastinate in doing their assignment tasks until they are close to deadlines before they become focused and concentrate to produce a very good job. Some of the students consider working on tougher modules first when it comes to the deadline so they could have enough time for submission. Some of the students work very hard when the deadline for the task is near. They are pushed and motivated by the deadlines to finish any given task quickly and to revise them before submission. Some of the students set specific times to finish their tasks and try to meet the set duration. Most of the students prefer to complete their work, in most cases under pressure, and meet the deadline so they can continue to a new task. Figure 7.42 illustrates a tree diagram of some of the discussion.

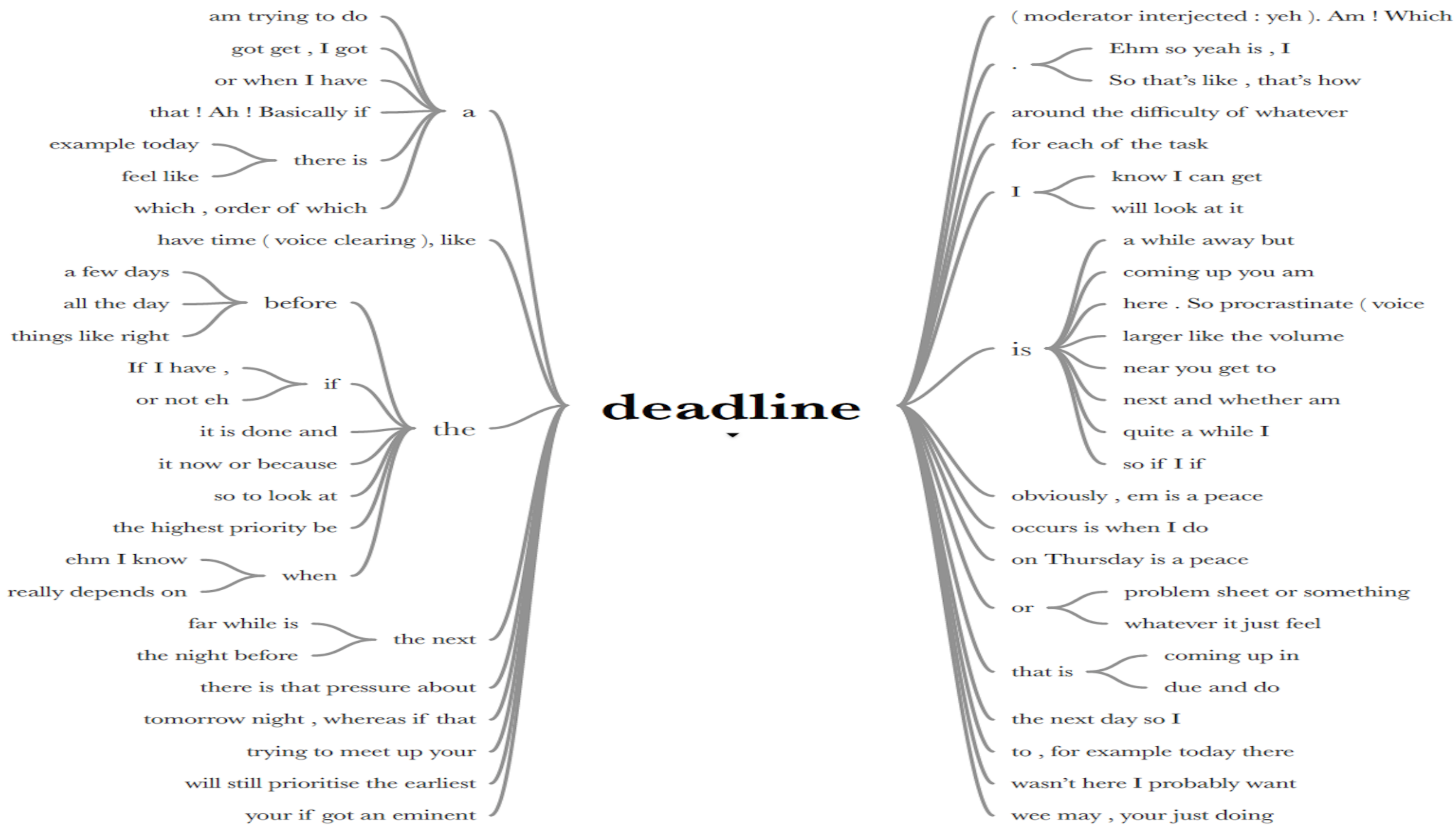

Figure 7.42: Visualising the code 'deadline' using a word tree generated from the focus group interviews.

Code definition: Indicator #2: Under Pressure

Some of the students are pressurised to work harder and submit their tasks on time under pressure to meet established deadlines. Some students mentioned that they work better when under pressure.

Code definition: Indicator #3: Travelling

A student acknowledged that when he travels away with friends for the weekend, he returns feeling relaxed with a mind-set to do his work. This sense of relaxation enables him to figure out an area he was struggling with and to find out the solution to it. The researcher observed from the student's enthusiasm that changing the environment seemed to help his studies. The attitude by the student enabled more productive work to be accomplished at the end of the term.

Code definition: Indicator #4: Group Study

Some of the students engaged in group studies with peers. These group studies enable effective exchange of knowledge and ideas which supports their learning. Another important activity concerning seeking help and support observed from the students is that, when one of the students learnt something new in their module curriculum, he discussed the topic with friends to exchange knowledge. This is a method in which he could learn effectively and understand more. The students claimed that studying in groups helped them to share new ideas and ask for assistance with difficult modules. When students were prompted by the researcher on whether they benefitted from the group study, they all agreed that they did.

Code definition: Indicator #5: Grades

The students mentioned that they reflected on their study when they saw their final grade and knew from the grade their weaknesses and strengths and worked towards further improvement. The majority said they knew that they had improved in their studies due to their high grades at the end of each assessment.

Code definition: Indicator #6: Advanced Knowledge

Some of the respondents became motivated to accomplish given tasks when they have advanced knowledge of what to do to produce a quality assignment. They tackled their tasks by trying to understand the questions before working on them. The students derived motivation from discussing with friends that have already completed the task. Several of the students were motivated to do their tasks using a consistent approach to tackling all their assignments.

7.9.3 Strategies

Code definition: Indicator #1: Listening to Music

Several of the students became motivated to study by listening to music, even in a noisy environment. They just continue with their work. While some listen to music with earphones, other students prefer music to be in the background softly while they study. This helps them focus on what needs to be done to meet deadlines. Most of the students in this focus group discussion said that listening to music while studying helped them remain calm during their learning activities. However, some of the students also claimed that, when they were trying to properly understand a concept in the module, they preferred a silent environment to avoid distractions. Lucy claimed that listening to music while studying stopped her from thinking unnecessarily.

Code definition: Indicator #2: Voice Chat

This is a new discovery in this study. A student learns and does a task via voice chatting with friends while doing his work. He said, he initially found it to be a distraction, but this habit of voice chatting with friends works for him in that it helps in his studies.

Code definition: Indicator #3: Playing Games

A student has used the attitude of playing computer games during his GCSE and A-levels and has transformed it into a good reading culture. At each point that he has lost a game, he begins working on his studies. He said that he only feels he is satisfied when he has jotted down repeatedly what he had studied on many pieces of blank paper. In this case, when he feels he has read enough, he then goes back to the game, and the same process continues. The student admitted that, since he loves playing games to the extreme, he just wants to use it to his advantage in studying and doing his work. This behaviour is seen in this study as a way of motivating oneself, setting goals, strategising a given task, and executing them to meet the deadlines. Another student devoted his time to playing cricket and just as the first student, after the game he studies. However, the difference is that, while the first student starts studying when he loses, the second student returns home after the game, relaxes a bit, and starts reading and working towards meeting his deadlines. Both are motivated to study by outdoor and indoor games.

Code definition: Indicator #4: Collaborative Learning

Some students felt that working with friends using a collaborative learning approach helps them to feel less pressure because it just looks like working with friends rather than worrying about the deadline too much. The researcher felt that this process enabled the students to relax and do their work without any panic arising. The students said that, to them, this is a better learning process *'in getting more of the work done as quick as possible'*, the learning pattern is like a group study. The only difference is that the choice of friends to work with in the group study could be decided by the tutor randomly or by the closest person sitting next to the students to form a group, or it could also be per the register. Group study and collaborative learning styles have been noted as being effective methods of learning [305, 288].

Code definition: Indicator #5: Googling

In terms of seeking support during study, most of the students indicated that they got help from using Google, asking friends, and other open-source resources to help them seek support. The students sometimes search, read, and ask online for any assistance from peers, friends, and other people on a similar network or sites, as illustrated in Figure 7.43. Some students mentioned that, when faced with challenges in a difficult module, they researched the subject to acquire more knowledge and understanding before progressing further.

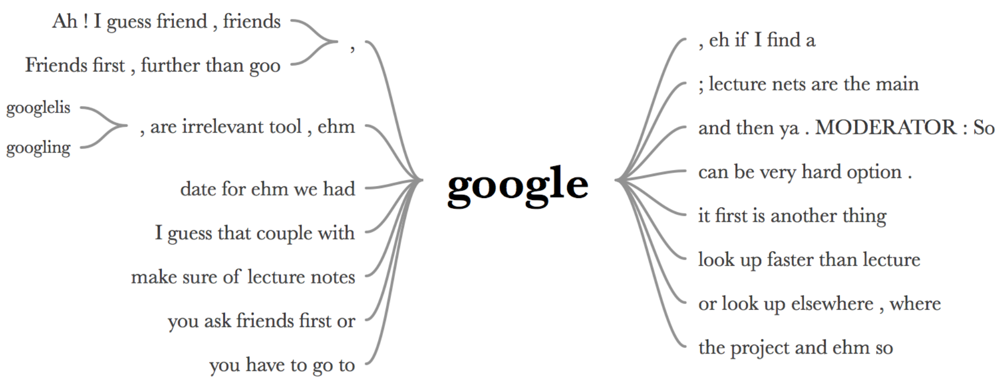

Figure 7.43: Visualisation of the code 'Google' using a word tree generated from the focus group interviews.

Code definition: Indicator #6: Priority

Some of the students arranged their studies based on priority by working on the hardest modules first. They did so because they believed that this would make the easy ones less difficult. Most of the students agreed with each other that they organised their studies according to the ones they found the hardest to understand. Some students mentioned that they worked around the task at that moment to meet the deadlines. The students work based on the priority given to the highest module with the nearest deadline due. Several of the students preferred to work on smaller tasks until they finished their assignments.

Code definition: Indicator #7: Drawing and Rewriting Lecture Notes

Some of the students felt that if they do not go to lectures, they are wasting their time. While other students take notes during the lectures and rewrite the notes later after the lectures, others preferred to just sit quietly during the lectures and listen to the lecturer and rewrite their notes afterwards. A student claimed that these habits of rewriting his notes makes the information and knowledge acquired remain with him for a long time. He said *'so that way it kind of like remain in me for a long time'*. Another student in this study had a unique way of rewriting his lecture notes, which was simply to draw out each of the lecture notes.

7.10 Analysing Statements from the Focus Group Discussion

Interestingly, most of the students never thought of the aspects of putting more effort into courses with high credit units, as reflected in the Table 7.14. These students allocate much time to modules that are interesting to them. About 67% of the students studied according to modules they are familiar with and the deadlines, so the aspect of higher credit units was not a priority. In contrast to the credit units, a large proportion of students (about 89%) said they planned before engaging with their studies. A full 100% of the respondents said they prioritise their studies and allocate more time and effort to tougher modules. In contrast to the previous two statements, 100% of the students do not allocate different times to their modules but occasionally allocate much time to harder modules that they were interested in, rather than those for which they lack interest. The reason is that this group of students works with deadlines and modules with high priority. For instance, a student said *'I put the time needed for something that needs to be done; if something* *needs to be done I put enough time towards it so that it would get done'*. Another student said, *'If I find something harder, I will allocate more time to that, even if worthless; I still think it is better to get that sorted before the rest'*. Therefore, they only solve and study the modules for which they must submit the course work or assessment. Some of the students in this research rarely schedule time in their studies because they have different deadlines, and they prefer to create extra time for which they are free to work on the other modules in which they are lagging.

Table 7.14: Important statements extracted from the transcripts.

Important Statements	**Yes**	**No**
I consider credit units as important as my modules.	33%	67%
I plan before reading my notes.	89%	11%
I prioritise my studies.	100%	0%
I allocate more effort to tougher modules.	100%	0%
I allocate different time for my modules.	0%	100%

7.10.1 Emerging relationship discovered from the focus group discussion

Figure 7.44 illustrates the emerging relationships observed among the students in their choices of views and reading patterns. The majority of the students agreed with each other's views, and they also derived inspiration to contribute to each other's opinions. This illustrates how similar patterns of learning equate to similar academic performance among the students of the focus group study. The visualisation represents some groups of students with a high level of contribution from these few selected themes discovered during the focus group discussion in this research.

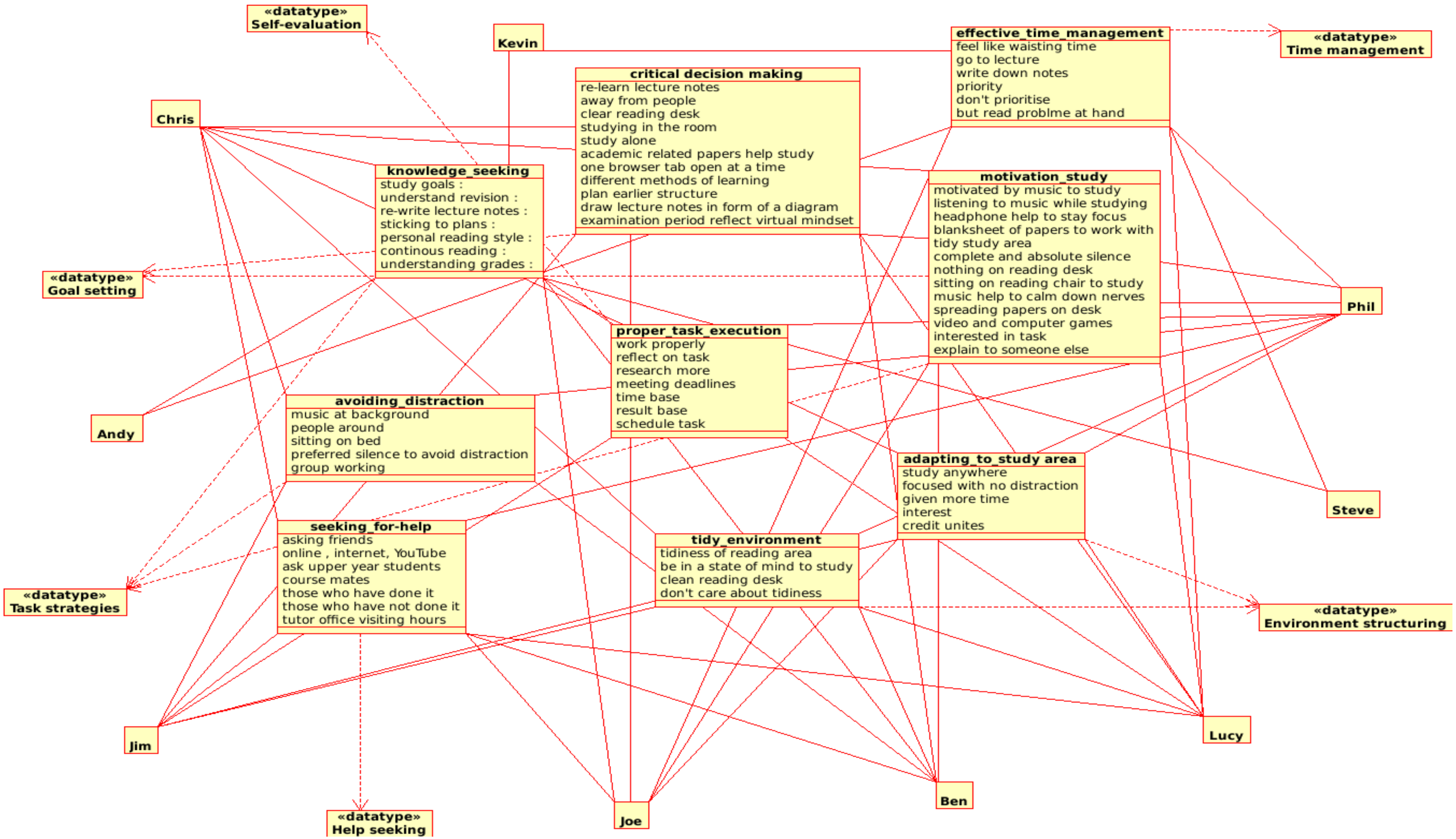

Figure 7.44: Similarities and differences in opinions discovered from the focus group interview.

7.11 Discussion

Self-regulatory learning of behaviours has shown positive mediation in the relationship between students' perceptions of blended-classroom learning incorporating online study and face-to-face study. These perceptions have also revealed the relationship to academic attainment in this study. According to Barnard et al. [29] and Kizilcec et al. [163], who argued that students who lack the ability to self-regulate their studies are limiting their opportunity of enhancing their SDL paths, reducing their chances of effectively benefitting from the course resources to achieve better academic performance. Self-regulatory learning, in brief, is the ability of exercising autonomous control over one's learning behaviour and environment [6, 30]. Our results indicate that the students' perceptions of SRL are unique to the individual students. At the same time, there are some similarities in their learning habits, and as we observe the various patterns of learning shown by this student sample, we undoubtedly observed similar learning patterns exhibited by the students in this study. In other words, SRL behaviours do mediate positive relationships between student perceptions of SRL dimensions in the blended-classroom context and strengthen improved academic attainment [28, 355, 221].

According to Barnard et al. [28], students who have a high level of self-regulation appear to have much better perceptions of regulating their learning as compared to students who have a low level of self-regulation with less positive perceptions. However, the study further explains that student self-regulation is not generally directly related to academic attainment as a measure using the grade point average (GPA). They affirm that the findings do not negate the importance of SRL behaviours, but rather inform online course instructions and course design. Equally importantly, students should develop positive perceptions of self-regulation before participating and engaging in an online course or blended-classroom course to benefit from SRL to a sufficient level, which could positively improve academic achievement [6, 108].

Blended-learning complements the traditional teaching approach and extends the advantages of these courses after school. In general, blended-learning employs a wider variety of learning resources and introduces different teaching methods and assessment tools [180]. This approach of blended-classroom teaching provides more choice and benefits the learners in enhancing their learning scopes [294]. Nowadays, with the development of modern digital learning platforms, learners can interact with the design and their studies at their own pace. However, the designs of these learning platforms require adequate attention to ensure students are developing the necessary skills to enhance self-regulatory skills to optimise SDL habits [304]. We recommend that blended-learning instructional course designers should develop learning environments where positive perceptions could be formed and fostered to encourage SRL among students [28, 108].

The research question in this study focused on the SRL skills demonstrated among students and investigated areas of interest that need improvement. One of our objectives in blended-learning has been to investigate whether the average SRL scores from these findings could be further improved from the blended students' perspectives. The overall average six dimension score for SRL reflects areas that require more improvement. All six dimensions need further improvement from the students' points of view to reach the threshold point for high SRL. There are some highly surprising findings from the SRL results, given that most of the students study using their own learning styles. However, most of the students, as learnt from the demographics, have not had any experience in blended-classroom sessions before coming to the university. Thus, at this point, they struggled to understand the rationale and concepts of SRL in a blended context. Although the students were very familiar with social media, they found this formal educational process new to them even though it is online inclusive learning.

The concept of SRL skills is said to be context dependent [357, 355]. However, some of these skills might vary between students depending on where their study strength dominates. There are several aspects of SRL skills that need further development in this study. The individual learner shows distinctive strengths in the different dimensions. Nevertheless, two students show average SRL skills individually above the threshold to benchmark the high SRL levels. However, when it come to the collective average six dimension scores for SRL, none of the scores were close to the threshold of 4 and above to meet the level of high SRL skills with respect to the dimensions. These findings in terms of average score are worrying, as most learners, about 88% (n = *15*) score individual average SRL scores of below 4 and only about 12% (n = *2*) of the students could score an average of above 4, as per Table 7.8 above. Even for experienced blended-learning students, the level of SRL skills is likely to be challenging. Currently, the lack of blended-learning experience of the students in this study could be a contributory factor to the low level of SRL skills, as observed in the findings. However, with the subsequent run of the module and with sufficient instructional information on the development of SRL skills, the results might improve.

7.12 Summary

There has been little research on the effects of using a MOOC as an online component of a blended-classroom approach. This study has used a theoretical perspective of SRL to investigate approaches to self-regulation adopted by undergraduate computer science students studying in a blended MOOC environment. The MOOC used for this purpose was developed on the innovative eLDa platform, allowing students to determine, track, and visualise their individual path through topics and materials offered in the MOOC. Data collected using a standard conceptualisation of SRL for online learning revealed relatively low average levels on several dimensions, notably, self-evaluation and time management. Our findings lend support to the view that SRL is a contextualised concept and that, although the group of students in the study were highly effective, high-achieving learners, they were not used to studying in a blended environment and many had not yet developed appropriate strategies or modified existing ones to be effective in the context. We should therefore not expect students to be equally effective in a new mode of learning, and some may benefit from more directed support for scaffolding and developing SRL skills. We also note that the preferred ways of study and effective practice reported by the students are many and varied and, with greater opportunities for how, what, and when they study, even students on 'traditional' university courses may now be studying in many ways as evidenced in the focus group analysis. Although it is likely that current generic dimensions, such as time management, are just as important as before, it may be that they are evidenced in different, unexpected ways for different students. There may also be additional dimensions that should be considered.

Although this study presents findings from a small data sample, it points to several areas for future implementation and exploration. First, in line with using an approach similar to action research, in the future, students' SRL could be tested early in the course with the MOOC component being ideally placed to provide personalised support for each student in aspects that they may benefit from developing further. Second, for students in the cohort studied in this research, a longitudinal study would track how their SRL develops as they progress through the degree. It is important to gain further qualitative data to understand how students work in practice and the strategies they adopt when confronted with different modes of learning. The main benefit of the semi-structured interview data is that they are extremely rich with information. Finally, it is necessary to consider the conceptualisation of SRL to understand if existing instruments could be adapted to provide a more accurate assessment of the effectiveness of learners' self-regulation.

Chapter 8

Discussion

This chapter revisits the thesis research questions, interprets the results from the studies, and compares the patterns discovered. Finally, it discusses how the findings relate to the theoretical framework and previous studies. This chapter conceptualises and addresses the following research question as a basis for the discussion:

RQ5. Are existing conceptualisations of SRL appropriate for MOOCs in standalone and/or blended mode?

Section 8.1 presents the main implication of the study. Section 8.2 presents the perception of self-regulation in a blended learning context. Section 8.3 presents the implication for the focus group sessions in this study. Section 8.4 presents the significance of the conceptualisation of SRL in this research. Section 8.5 summarises the chapter with emphasis on the significance of the study and a preliminary discussion of the research contributions.

8.1 Implication of the Study

The online course participants were mostly professional learners and some university students for which we hoped to obtain adequate SRL skills from the investigation. However, several factors showed that there is a need for improvement in one or two of the dimensions from the learning cohorts. The blended class on its own is made up of inexperienced first-year undergraduate students who have not participated in a blended-learning course prior to this study. The results from the blended sessions show low SRL skills in almost six dimensions, and although there are some individual dimensions that are somewhat higher, the majority need improvement. This study has observed and judged that, although the level of SRL skills in this blended cohort is less, the students' weekly assessment results from the traditional class show otherwise. Recent conclusions drawn from some studies demonstrated that learners who practice effective SRL skills perform better academically as compared to those with little or no SRL skills [29, 349, 355].

In the literature, we emphasised that adequate SRL skills have been associated with effective learning, but our results seem to indicate that students with poor SRL levels are studying very effectively. Hence, this conceptualisation of SRL may not be adequate for this study. In this blended-learning study, the students demonstrated better results, as seen in their weekly assessment grades, even though there were poor or low SRL skills among the students, as reported in the results. This study could draw initial conclusions that the adopted OSLQ applied in other studies revealed and interpreted important findings from the results. In this case, adapting a similar framework would not necessarily be applicable to the aspects in this study. This explains that different students with diverse reading cultures could have affected or influenced the possibility of accurate SRL skills, which generally cannot capture the learners' cognitive imagination from this centralised instrument using the same questions.

In terms of overall SRL scores, this illustrates that the participants in both case studies understand the need to set goals and planned strategies to achieve a successful outcome. The learners in both studies chose a suitable learning environment to avoid any distractions. However, the overall SRL scores in Table 7.7 and Figure 7.24, show that the students in the blended-learning course lack the ability to self-evaluate their studies and manage their study time effectively, but the learners in the standalone online course showed the ability to self-evaluate their studies and manage their study time effectively, as shown in Table 6.2 and Figure 6.6. In terms of skills for seeking help, the study observed weakness in this dimension among the learners in the standalone online course. However, the blended-learning course shows a much better ability to seek help among friends during their studies.

The low level of SRL observed between the two case studies was rather similar. The online learners and the blended-learning students show independent learning patterns. However, the participants in both case studies lacked the ability to seek help. The results in terms of mode between the case studies showed that most of the online learners preferred to self-direct their learning; likewise, the blended-learning students switched between self-directing and instructor-led modes. There was an option to switch between modes within the course platform, which several learners took advantage of to help them acquire the full understanding of the course curriculum. The participants in both case studies appeared to have confidence in directing their learning process. In this case, they decided not to seek help or engage in any form of social learning process. Although the results presented here are from a small population sample, they indicate SRL dimensions from the two main modes of learning in this study: self-directed modes and instructor-led modes.

8.1.1 Implication for learning modes

Each of the learning modes in this study can help learners achieve significant milestones in aiding learning due to the switch from one mode to another during the learning process that was made flexible in this study to allow learner autonomy. The SRL skills of the learners could be identified from one learning accomplishment within a mode, which most likely could be bridged across to the other learning modes during the transition. Nkuyubwatsi [220] argued that the 'combination of learning modes, where applicable, can lead to better learning experiences than an exclusive use of a single mode'. However, this is reflected in the findings of this study. The results demonstrated in the mixed modes of self-directed and instructor-led learning were clearly observed, as shown in Chapter 6.

In this study, semi-structured interview questions that were created with open-ended formats were used. The questions led to the exposure of aspects of SRL among the students. The reason for constructing the questions was to reveal some aspects of SRL in the focus group discussions. The researcher hoped to measure students' distinctive patterns of engagement with their studies. These results show a student group that is highly engaged in learning, using similar learning approaches in some cases and some different individually tested improvised approaches in others. However, this group of students indicated and demonstrated that they were not yet as well engaged as they could be in their broader learning development. The reason for this was largely due to the close nature of different course deadlines. The students must prioritise their reading patterns and adjust their learning schedule to give priority to the assignments that must be submitted earlier.

8.1.2 Implication for students orientation

The phase of planning in this study as addressed by Zimmerman and Moylan's model [353] underpinning the cyclical manner of SRL, forethought performance phase, self-reflection, and how these influence each other. Anecdotal evidence revealed that several students did not know how to take their study and strategic planning seriously, but selected modules based on what was interesting or followed the choices their friends made. They did not seem to have any concern about their selected modules or courses, or whether this could be related to their career goals or higher achievement goals [13]. Many students coming to the university choose courses without any specific interest or goals, and when they observe that they do not fit with this course, they tend to put less effort into the modules of the course [142].

Another common concern in this study is that the students do not perceive the importance of courses with higher credit unit weights. They do not place much importance on some of the mandatory modules. Most of the students seem to devote much time to the basic modules they could easily understand and ignore the tougher ones for a while. This behaviour could be very dangerous, as the deadlines for assignment submissions and examinations draw closer. In this case, the high-level career goals of these students are not easily viable, and this might have a negative effect on their motivation to study. It seems that there was a gap between the students' task strategies and their goal setting, which ideally should complement each other and be connected to achieving career and academic success.

The students tend to limit themselves to what they know and want to know without creating the time to explore in-depth their potential and what they could achieve. They tend to misjudge their level of skills, and in most cases, focus only on how to pass their assessments and examinations. In a like manner, some students study when they have established deadlines and cut-off dates for assignments. Their goal orientation is to be successful and achieve their desired future career. This is the main ambition of all the students: to do well and obtain a better job after university. The study shows that students and learners who have poor goal planning skills might hinder the whole process of SRL investigation in the studies [13]. It is of great importance for the students to plan and set their goals on the high-level topics that they could select to achieve high academic standards to support their chosen degree programme.

8.1.3 Self-motivation

In the second experiment of the thesis, we explored students' motivations. This exposed the reading culture or behaviour of the students. The focus group interview revealed the various modalities and strategies incorporated by the students to help them study effectively at their own pace. One of the most intriguing aspects of this study was that some of the reading patterns shown by these students were quite similar in many ways among the students. They tend to complement and agree with the views shared by other students. For example, several of the students were motivated to study after playing games, others were motivated by listening to music, voice chat, and drawing their lecture notes. When probing questions were asked about the priority of the study, some of the students said they placed more effort on studying the tougher modules, as they believed when they started working on the easier ones, it would be extremely easy to work through them. However, these behavioural attitudes might not be the case with all modules, as approaches of delivering them are different. On the other hand, other students focused on the task currently at hand until finished before moving on to the next one. Understanding a course requires adequate preparation and time to concentrate and obtain the optimum academic results. The students in this study devised a means to better understand their studies and intuitively planned avenues for motivating themselves while studying.

8.1.4 Variation of self-regulation of learning

One of the research questions in this study focused on the SRL skills demonstrated among students in a blended-classroom to investigate patterns of self-regulation and discover areas that might benefit from improvement. The overall average score for each of the six SRL dimensions shows that in no dimension does the group reach what we have classified as a high level of self-regulation. This might be thought to indicate that all areas would benefit from improvement for most students. From the demographic data, it was found that most students had no experience in blended-learning, so it may be that, at this stage, they were still coming to understand the rationale and concepts of SRL in a blended context.

It is interesting to note that these students are high achievers, in the sense that they have obtained entry to a highly selective research-led department at one of the top universities in the UK. Hence, they would be expected to be effective in self-regulating their learning. The scores obtained in their weekly assessments indicate a rise by the third week, which could support the hypothesis that there is a necessary adjustment to study within the blended environment in the most effective, self-regulated way. As high-achieving students (and with appropriate support), class members could start making the necessary adjustments to their learning behaviour in the period of the study, and it might be predicted that this would improve further as they became increasingly used to the mode of study. This explanation aligns with the view of SRL being a context-dependent concept [357].

Considering the profiles of individual learners, there is a notable variation between learners with respect to self-regulation. Several obtained average scores of over 4, indicating a very good all-round attainment on all dimensions. This contrasts sharply with the students whose averages are lower than 3, indicating that they actively disagreed with most statements that would demonstrate their engagement with online SRL practices. Again, this reinforces the message that students who are effective, self-regulated learners in one mode of learning cannot automatically be expected to self-regulate in an unfamiliar mode.

Support is therefore needed to help learners adjust and develop their practices of self-regulation for learning when we confront them with a new approach to learning. First-year students who are used to a very structured traditional classroom environment in their school may need support in some aspects of SRL for blended-learning. Furthermore, given the different patterns exhibited by students across questions even within a single dimension, it is possible to offer appropriate scaffolding targeted to each learner's personal profile. Looking at the skills that were generally most lacking at the point of SRL assessment, we note that self-evaluation and time management are lowest. Time management is often noted as a common problem for many students, and it may be that a blended mode of learning, which allows greater autonomy of study in at least part of the course, may present additional challenges. For some students, it may be that scheduling tasks at the same time as other work and social activities is problematic. For others, the distraction of working online might be an issue.

There could however be a different interpretation to our findings. Although the current study has concentrated on the quantitative data, the free-form response questions did allow students to express some of their ideas and experiences of studying. It is interesting to note that, in these responses, students indicated some of the strategies that they felt helped motivate them to study, schedule tasks effectively, and manage their time. A student described how he would challenge himself in playing an online game; when he loses, then he starts to study. Another student found that he studied best immediately after playing sports because he felt motivated and able to work more effectively. Others were motivated to learn by listening to music, by voice chat learning with friends, and by drawing their lecture notes.

These strategies obviously differed between students and the 'self' aspect of SRL underlines the importance of helping students to discover what works best for them. Furthermore, traditional conceptions of what constitutes effective study practice may no longer be universally applicable. Research investigating study habits reveals a range of (sometimes surprising) activities, which appear highly effective for individual learners [223]. Hence, it may be necessary to ask whether questions asked in the current survey instruments are the most appropriate to investigate the concept of SRL and indeed whether the conception of SRL that informs them is suitable for novel learning contexts.

8.2 Perception of Self-Regulation in Blended-Learning

Blended-classroom learning is an approach of teaching and learning using online course resources in a conventional class setting [256]. In this case, the students engaged with the course content at home and face-to-face at an institution classroom [125, 45]. With the popularity of MOOC, information about blended-classroom MOOC has less exploration. This study has introduced and investigated online blended-classroom teaching in a MOOC context. The study also investigated SRL habits among students in blended-classroom teaching. Online blended-learning has emerged to become a new paradigm within the modern educational system. However, like the other online learning approaches, it has not been completely successful [296]. The exploration of such failures in this study is observed in ineffective perceptions of self-regulatory behaviours in learning.

One of the main objectives was to investigate and describe SRL in a web-based online and blended-learning environment. The study was conducted using both face-to-face interaction and web-based student learning approaches in a complementary way. The blended-learning environment was embedded in a novel MOOC platform called the eLDa learning tool. The study explore the perceptions of SRL behaviours, which have been associated with better academic attainment and the imperative to achieve better learning outcomes. In the blended study, we investigate whether SRL patterns could be considered mediation in the relationship to attain better grades and distinguish different levels of SRL dimensions [28]. The results indicate that students' dimensions of online SRL patterns, although not totally conclusive on education achievement in themselves, do show the relationship of the perceptions of online blended-learning course with academic improvement.

Research overall has proved that students need more personal self-regulatory discipline to be able to succeed in online blended-learning [4, p. 13]. Self-regulation was said to be the desired outcomes of the learners in the process of attaining their learning goals whether in online blended face-to-face learning or purely online courses. The students developed thoughts and behaviours to help them achieve the desired learning objectives or goals [355, p. 125]. The significance of SRL to academic success cannot be overemphasised. Several studies have shown that students who can regulate their learning perform better academically, compared to those who regulate their learning patterns less [355, 269, 163]. Popular examples of self-regulatory dimensions applied in this study are goal setting, task strategies, time management, environment structuring, help seeking, and self-evaluation. Some of these self-regulatory dimensions are more explicit, for instance goal setting, while others appeared more implicit, for instance environment structuring (for example choosing a quiet place to study). However, whether these dimensions are explicit or implicit, it is imperative to mention that these might have an effect on the attainment and improvement of the learners.

Self-regulation of learning in online-blended and face-to-face learning environments is different, as the students are autonomous and proactive in their learning. The students set goals, avoid distractions, and engage more with peers and the instructor to obtain support in their learning [6]. Students in blended-learning should engage more with SRL patterns regularly [28]. In the light of this development, SRL behaviours form the cognitive perspective of the learners. Environmental factors greatly influence this, rather than personal or behavioural factors [355, 268]. The perceptions of the students in the blended class flow across time management and the goal set aside for achieving individual personal learning routes rather than influence from the environment. In this case, the perceptions of self-regulation are undoubtedly influenced by the students' personal behavioural patterns in learning. The learners and their ability to develop individual SRL skills suitable to their chosen learning patterns influence academic success.

Every student in this study is unique in his or her learning, which is the primary factor for academic attainment, followed by the factors of learning introduced in the blended context, such as new concepts, learning resources, peer support, and tutor help. In a general note, the initiator in the first instance is certainly the student, which is equally imperative for attaining set goals, task strategies, and achieving expected objectives. In addition, Zimmerman and Schunk [355, p. 119] pointed out that these self-regulated behaviours are mostly context dependent, which cut across all domains according to the situation and 'learners are not expected to engage in self-regulation equally in all domains'.

Hence, this study hopes to further analyse SRL strategies for blended-classroom instruction as well as to support instructors and students to find avenues for improving and enhancing efficient knowledge acquisition. This research has presented the preliminary results from a blended-classroom seminar designed for first-year students. The results were captured based on students' responses to survey questions designed from the initial adapted MOSLQ instrument, which was designed to measure SRL dimensions. Several theories reveal that participants in a blended-classroom decide the approach to follow in studying using familiar learning habits suitable to their required needs [304]. The investigation of SRL in the blended-learning context allowed for better information as to how or whether the learners prepare and plan to achieve any academic set goals [29]. The data analysis in this study helped show the motivation and cognitive behaviour of the students.

8.3 Implication for the Focus Group Session

During the focus group interview, students motivated each other in the discussion and peer-to-peer interaction. For instance, when a student mentioned that music supports and helps them in reading, other students were inspired, and they also remembered they could also read better by listening to music to avoid distractions from the environment in which they were studying. This shows that their initial understanding of the question was not clear until a prompt from colleagues' contributions; this increased the pace of the discussion. However, while some learners found music to be a distraction during learning, this group of students saw this as an incentive to support their learning. The students' experiences show the relationship between their reading patterns and their academic achievement. Related words were echoed all through the focus group interview, as most of the learners supported one another in an overlapping conversation.

In view of the context, the focus group interview questions, the prompting from the moderator, the group interactions, and the overlapping conversations during these sessions influenced the contextualisation of the discussions that were established during the study. The students were never asked to directly discuss any private or personal experiences that they were not comfortable sharing with the rest of the focus group participants. However, conversations regarding learning styles that were personal to some students and from which other students could gain knowledge were shared. In this case, other students could learn and agreed they had similar learning habits. Bickman and Rog [38, p. 594] mentioned that focus groups interviews allow respondents to contribute to and develop the responses of other members of the group. This process is known as the 'synergistic' effect of the group setting, which may result in the production of data or ideas that might not have been discovered in individual interviews. At this point, the students recounted the individual learning experiences that had worked for them and those that needed improvement.

They also freely discussed previous learning habits that were not helpful to them and for which they did not benefit. They explained how they modified their old learning habits for their success. For example, a student mentioned how constantly playing video games and computer games affected his A-level and GCSE grades drastically. The student decided to incorporate his love of gaming habits in learning. The student developed a self-study mechanism using his habitual gaming activities. When the student was prompted by being asked 'how do you know you have read enough satisfactorily?', the student commented that this was because he liked studying by writing with several papers and that if he observed that his reading desk is full with these papers, it is an indication that he should stop and play his video game. He then added that when the papers were all over his room, he knew that he had achieved enough to the point where he could play a video game. This process continued throughout this student's studies and has become part of his reading style. Other students in the focus group discussion agreed on similar learning patterns of playing video games and studying. There seems to be consistency in the discussions in terms of students agreeing with the comments of another, for example, when a student mentioned that they preferred to learn in a quiet environment, generally, most students agreed with the comment. Another example in terms of mode of learning was that most of the students agreed that some times they prefer to self-direct their learning, and also need an instructor to guide them in their learning modes.

The frequency and extensiveness of comments shows how often a view has been expressed and demonstrates the effect of such comments during the session. The frequency of occurrence is demonstrated by the word count in the focus group interview transcripts. The term extensiveness of comments refers to the number of students that expressed the same view and were inspired by others during the discussion sessions. The students in this study engaged effectively and expressed their views based on their experiences in response to all the interview questions. They were confident in their expressions because they were familiar with each other in a more relaxed and friendly environment. There seemed to be several associated views and comments, which revealed similarities in the learning patterns among the students. For instance, a student liked constructing reading timetables using Excel spreadsheets according to priority and crossed-out or marked the topics read, while the other students also agreed by saying they prioritised their reading according to the closeness to the deadlines. All these are laudable means of reading patterns developed by individual students to support their education and to attain better academic achievement.

In this study, we considered the feelings of the students and the comments expressed during the discussion on specific experiences during personal study or group work. Some of the students mentioned that they read better in their rooms with no contact with others. Another student said that group mates did not really like the way he conducted or approached group work. He said that group work was out of his comfort zone and that he did not like group work. This student said that he was uncomfortable doing group work, he preferred working alone. He gave an example of how some students panicked constantly regarding deadlines while doing group work, thereby making others feel pressured and depressed. At this stage, he tried to calm down these students, but their anxiety increased and he ended up doing the project alone. This is one of the reasons he detested group study; this attitude could lead to feeling pressured and not finishing a given task on time. Additionally, he said that when a group had different opinions on how a given task should be done and vice versa, this also affected the progress of the work. Another student read in the common area in the flat, for example, in the kitchen where a cup of coffee could easily be made. However, when flat mates turned up, they made a lot of noise, and the student then became distracted and not much work could be achieved. This student then said that for effective reading, he goes to the library.

In another situation, some students preferred reading with others in the laboratory, where they could be working on programming exercises together and sharing and learning from one another. In this case, more attention is given to the students' personal learning habits and how this could influence their judgement in reading. For example, several of the students make up for lost hours by sacrificing their sleep to meet the deadlines. However, this behaviour could lead to a lack of sufficient sleep, which could result in pressure and lacking full concentration during the next day's lecture. These overnight reading patterns discussed by the students explain how they made up and studied modules that they are not very good at. Other students agreed they would constantly read the tougher modules and schedule more time to them until they fully understood the modules. This study has demonstrated that students tend to study hard when they are interested in a module and the aspect of the course volume or credit weight units does not matter so much to them. If they are enjoying the module they will concentrate and do well in it. The various attributes developed by these students helped to motivate them in effectively engaging with their studies to achieve outstanding weekly scores, as shown in Tables 7.10 and 7.9 in Chapter 7.

8.4 Significance of Self-Regulated Learning

Self-regulated learning refers to learning that is directed by a metacognitive reflection on one's own learning process and by the conscious choice of appropriate strategies to maximise learning [350, 349, 21]. Self-regulated learners do not simply seek to take in information presented to them, but are proactive in taking control of their learning [349]. Self-regulation is itself affected by motivational factors, such as the learner's commitment to current learning goals and their belief in their own capability to succeed in the learning endeavour (that is, their self-efficacy) [351, 22]. Self-regulation is generally characterised as comprising several distinct dimensions that play a central role in learners' motivation, engagement, and learning behaviour [96, 42, 21, 351]. Moreover, SRL is strongly associated with a range of positive outcomes, such as high attainment and lower dropout rates [350, 170, 178, 59]. It is therefore highly desirable to understand students' levels of SRL and to help students recognise and improve areas of weakness.

Several conceptualisations for SRL exist, and, based on these, several survey instruments have been developed to investigate students' capacity for SRL and to expose areas of weakness that need to be addressed [350]. These have been deployed in both traditional settings and e-learning contexts. For example, in studying SRL of learners within two MOOCs, Milligan et al. [215] found that those with high SRL levels were more likely to set specific learning goals. However, the concept of SRL and the activities that evidence it may differ according to the various learning contexts. The most effective strategies for scaffolding and supporting SRL may differ between types of students and modality of learning [304, 331]. Furthermore, the role played by SRL in distinct educational settings may be different. For example, investigating the way in which the self-efficacy aspect of SRL relates to other elements within a community of inquiry, Shea and Bidjerano [277] found differences between the effects noted in a blended-learning environment and those observed in a fully online course. While the implications of such results need further investigation, the work clearly points to differences both in what constitutes effective self-regulation and in the difference that such skills make within various learning environments.

Another connection made in some studies is between learner autonomy and self-regulation [349]. A mode of working that allows students the freedom to make decisions about what and how they study can encourage them to take control of their own studies, helping them to engage better and achieve better academic performance [208, 47]. In this respect, it might be thought that blended-learning has a distinct advantage in that students experience autonomy in part of their study but are also given some direction by lecturers. This may be a promising scenario for developing SRL skills in a supported way. However, it may also potentially cause some confusion if the skills required differ between environments. Differences have been noted in the levels of action control between higher and lower achievers (an aspect of SRL relating to the ability to ring-fence time on task despite competing demands) [304]. However, it is unclear whether this applies equally to the different blended modes or whether it is significantly different from single-mode learning. Other areas of difference may also be relevant in the blended-learning context. For example, students' different motivational beliefs have been shown to have an influence in promoting and sustaining their SRL [236]. Hence, differences in motivational approaches to learning modes could potentially lead to material differences in a learner's SRL between those modes.

8.5 Summary

Although there have been suggestions that some traditional dimensions of SRL conceptualisation may have less (or more) significance in a blended-learning context, it is not yet understood which aspects this applies to or to what extent the differences occur. For example, Lynch and Dembo [195] found that neither the dimension on help seeking of SRL nor a capacity for self-efficacy were predictive of success in a blended-learning environment. In our case, there was no indication as to whether levels of help seeking and self-efficacy were truly lower or whether the questions asked were not correctly targeted to elicit information appropriate to the modality of learning. This points to the need for further research that fully explores the issue of self-regulation in the context of blended-learning to understand what constitutes SRL in different modalities and how it can be fostered.

Existing research clearly demonstrates the benefits of analysing learning data and applying the results to inform better course delivery [110]. To better understand how learning technology can enhance the learning process, it is necessary to investigate both the learning environment and the experiences of the learners themselves in relation to the environment. This study investigated dimensions of SRL exhibited within a standalone online course and a blended-learning computing class. The blended element was provided by a MOOC, which was itself implemented on a novel platform that supports users' choice of learning path, hence increasing the opportunities for learner autonomy.

The tool of this study visually presented the course curriculum, which allowed the learners to interact with the course and regulate the resources in their own chosen route. The results from the pilot study provided an earlier understanding of how learners approached the course. This provided evidence on the course structure that participants were willing to engage with. The negative side is that the learners who engaged with the pilot study did not practice most of the course surveys and quizzes. As a result, this investigation became continuous to the launch of the live online course. On the plus side, the feedback gathered from the trial run supported the development of the new course structure. In the experiment conducted using the blended-learning approach, the results showed low SRL skills among the students in the study. Despite the failing level of SRL skills observed within the dimensions of the study, the students' weekly assessment scores in the university showed high achievement during the term.

In terms of the amount of work required to develop the course, it was manageable, as most of the content was re-usable from the existing platform. However, the entire platform structure, content visualisation, blended-learning course, and concepts were newly created from the very beginning to support the research objectives and investigation. The mapping of the course curriculum to the paths of learning outcomes allowed for a connection with topic lessons that led to achieving distinctive goals. There are few MOOC platforms that investigate the concept of SRL among the participants. This study's contribution showed that, in a blended-learning MOOC system, the learners could direct their study as they so wished differently from the instructor's design plan. In addition, to emphasise the main contribution of the platform, this study explores issues related to SRL in the novel (eLDa) platform. The main contribution of the novel platform used in this study is that it helps foster learners' self-direction and supports learning processes. Chapter 9 addresses the research conclusion, discusses the summary of the findings, and elucidates more on the research contributions.

Chapter 9

Conclusion

The previous chapters have successfully achieved the research goal by investigating SRL among online learners in a standalone MOOC and students in a blended-learning environment. The ultimate goal of the research is the development of a viable explanatory model to investigate SRL habits among MOOC learners. The future directions suggested here will provide a means for further exploration and development. The findings that emerge from these two case studies could conceivably make available a refined tool with observational and theoretical generalisability. This chapter summarises the findings from this research work. Section 9.1 presents the main research contribution to the field. Section 9.2 presents the research challenges and limitations. Section 9.3 presents best practices in MOOC development, possible recommendations, and directions for further research work. The chapter is summarised based on the following research questions.

RQ1. To what extent is self-regulation needed, promoted, and supported in current mainstream MOOCs?

RQ2. What patterns of learner activity and resource usage are observed within a MOOC that support learners' choices of different learning routes?

RQ2.1. *To what extent do learners choose to direct their own study path as opposed to following a guided course?*

RQ3. Does a learner's capacity for self-regulated study relate to the choice of learning paths and the ability to succeed in a MOOC?

RQ4. What levels of SRL skills are observed within students' learning in a blended-classroom context and an online course learning context? What are the areas of deficiency that need improvement?

RQ5. Are existing conceptualisations of SRL appropriate for MOOCs in standalone and/or blended mode?

RQ6. What are the implications for MOOC pedagogy to foster SRL?

We do not claim to have resolved the issue of the high dropout rate in MOOCs. The study does hope to have contributed in one way or another in revealing some aspects and filling in some of the gaps explained in the literature in Chapter 2. Following the pilot implementation and analysis of the results, the eLDa platform was improved to established the full components and functionalities necessary for the learners' needs and set the preparation for the live course launch. This study has revealed that a student-centred approach towards course development and design is viewed as improving the learners' autonomy and learning experiences compared to other e-learning courses designed with the concept of a one-size-fits-all approach as observed in most MOOCs. The pilot study has facilitated the consideration of the learners' needs while improving the course structure to ensure adequate learning experience and continuous participation. Further research is necessary to investigate and clarify the remaining and newly discovered issues.

9.1 Research Contributions

The findings and outcome results obtained in this thesis bring many research perspectives for good practice in MOOC pedagogy in general and led to adequate awareness of the usefulness of the conceptualisation of SRL in a MOOC context. We believe this and future directions to be worthwhile endeavours, as we demonstrate that good MOOC pedagogy could foster SRL and help learners self-direct their learning. By investigating SRL skills among several selected blended-learning students, the study aimed to gain deep understanding of how students individually regulate their studies daily and of the drivers that motivate and influence the strategies they use during learning. Among these responses was a striking discovery; the students were asked whether they have participated in a blended-learning course prior to this study, and surprisingly, the majority of the students said that they had not previously participated in a blended-learning course. The survey questions and focus group interviews revealed more concerning the self-developed strategies of learning of the students from the SRL investigation and findings in this study.

This study also revealed that SRL has not been fully harnessed in both standalone online courses and blended-learning courses. The literature exposes the gaps and the need for learners to regulate their learning habits effectively. We were able to extensively review relevant MOOC literature to identify the areas that need the incorporation of SRL. From the research findings, we also understood and discovered ways of improving the theoretical framework to support SRL in a MOOC pedagogy. The study also revealed and observed that existing MOOC platforms lack good pedagogical structure, which is as a result of insufficient good practice in course instruction and platform design. Our study helps to inform good practice in MOOC design and pedagogy. One of the main design goals was the establishment of the learners' choice of path while engaging with the course to help them take control of their learning.

To investigate the pattern of SRL activities in this study, we adopted six dimensions as interventions aimed at exploring the learners' SRL awareness. The platform incorporated lesson prerequisites that were linked to learning resources to support learners in a guided route of study. This study shows that learners participating in the course were good at selecting a learning mode suitable to them. The findings revealed that most of the learners demonstrated the desire to be autonomous by developing their individual learning goals. The platform tool provided support for learners to further develop and improve upon their own goal setting skills. This was made possible by the effective navigation concepts, functionalities, and mechanisms for guidance introduced in the platform design. The tool supports learners in their unique and different learning preferences by providing a decoupled course format where learners are supported in the path suitable for them to achieve their learning objectives. Learning autonomy was fostered in the platform tool by allowing the switching between routes of study within the course modules. This was achieved within the standalone online course, and this approach can be extended to work within courses with the same support concepts.

The contribution from the research framework demonstrated that the overall levels of SRL need considerable improvement in this study, with few of these dimensions scoring above the threshold mark. This is surprising given that most of the learners were experienced professionals in their respective fields. Nonetheless, this study allows autonomy in learning, which most of the learners took advantage of to help them take effective control of their learning. This feature enhances self-direction which could further improve the level of SRL and allow learners to benefit effectively from self-directing their learning.

The novel feature of the eLDa platform, allowing learners to set their own learning goals, informed the participants to develop skills of SDL. In line with the design science approach, the study was able to foster and promote social aspects of learning by incorporating effective communication media between the learners and the tutor. This functionality helped to promote and encourage the enhancement of the strategy of help seeking. As well as developing support components, the platform helped foster awareness within the learners of the need to develop these six SRL skills via the questionnaires. The study was able to ask relevant questions to inform the participants of the uniqueness of having these SRL skills while learning and the effect these will have on their studies and professional careers.

Another approach this study used to inform this knowledge acquisition was through providing prerequisite navigation and choice of routes in the eLDa tool that helped to improve learners' SRL skills as identified from some questions. Hence, this helped to improve the establishment of realistic learning objectives, setting reasonable goals, and building up skills to pursue these goals successfully.

The results from the second case study in Chapter 7 indicated that the perception of SRL among the students seems to be unique to each individual. As this study understands the learning patterns of the blended-learning students, we observed that similar self-motivated learning strategies and behaviours were displayed and used in their study. The blended-learning course approach provides more options and opportunities which students can explore to benefit them in enhancing their learning skills. The results from the overall SRL dimensions present areas that required improvement among these highly effective and high-achieving students in the blended-learning course. The blended-classroom seminar survey questions revealed how the blended class has motivated SRL among undergraduate students.

This blended-learning class case study aims at initiating the first step in supporting learners in building SRL skills. The course introduces instructional approaches in leading students to the resources necessary for their studies. This recommendation helps the students to be focused and to strategise their tasks and plan their set goals before attending lectures or seminar classes. This helps them in building SDL skills to support future learning. The instrument does not show the true nature of undergraduate students based on the findings in this study. This contrasts with the earlier theories that students in a blended class or online environment with high SRL skills perform better academically as compared to those that have low SRL skills [147, 108, 215, 195, 163].

However, our study results show that the majority of the students have low-level SRL skills using the adapted instrument. Nonetheless, when it comes to their weekly assessment, the average score is very high; that is, the students in this context perform highly in the blended-classroom seminar. This reveals that it is not true in all cases, as mentioned in some studies, that students with high SRL abilities always perform better academically as compared to those with low SRL abilities.

The findings in this research are similar to those reported in a study conducted by Pintrich et al. [238], and show that the OSLQ instrument format that was adapted did not in any way represent a holy grail or a good standard instrument for high-level student achievers in this research study.

In addition, it may be seen that the questions of the instrument that were adapted to suit this research did not in any way obtain the most useful information from the blended-learning students, as they all effectively strategised and planned in their own distinct way of studying, which was suitable to them. The contribution and recommendation is that, before constructing or developing any SRL questions, there should be semi-structured interview discussions to gather the initial thoughts of the learners. Thus, we believe when instrument questions are tailored to the learners in the context, useful results might emerge to advocate for proper findings and contributions.

In contrast, these low level SRL skills did not in any way affect students' performances. This shows that student academic performance increases in a dynamic way above the average pass mark. Therefore, the SRL enhances better academic performance, but in our study, a greater percentage of students were new to blended concepts but developed individual strategies to succeed in their studies to achieve better academic success, as referenced in the average weekly assessment scores in Table 7.9. The students' autonomy has led to better grades, even with this lack of effective SRL skills (see weekly assessment marks in Table 7.9). The SRL skills observed among the students in this study overlap from student to student based on their learning strengths. The individual students in this study show distinctive SRL abilities.

However, the low level of SRL dimensions observed in this blended-learning might be because of the lack of experience from the students. With the subsequent run of the blended-learning course, we hope to see the level of SRL skills improve based on the experiences gathered from this study. Further encouragement of developing new skills will be pursued to create both implicit SRL skills that foster SDL and allow students to take control of their learning activities and explicit SRL skills that direct students to self-evaluate and reflect on enhancing their SRL skills. Thus, further methods of introducing new concepts, such as explicit goal setting skills, would be easier for the students to understand.

This study investigated learners taking the initiative to control their learning and how the novel platform tool has supported the learners in making informed choices towards directing their learning paths. The tool was able to foster the SRL skills by making effective use of features to support the modes of learning.

Self-directed opportunities were offered to learners as well as guided opportunities led by the instructor. The main purpose of the instructor-led approach was to introduce lesson prerequisites that led the learners to specific (navigation) links containing resources that are associated with their current lessons. Although the tool allows flexibility of learning paths, learners were not forced to comply with the prerequisites. They could at any time switch the mode of study for one that they felt was suitable to the course content they were engaging with at that moment. The two main routes of study were decided by the learners, and they were free to change from one route to another with the support of the features introduced in the eLDa tool. Some studies showed that appreciating new features in learning tools could be seen from the perspectives of different learners, as not all learners welcomed changes in their routine e-learning environment, irrespective of the benefits [209, 101].

At the beginning of the course, the learners were given the options of two routes (self-directed and instructor-led) to follow to engage effectively with the course. When learners opted for the self-directed routes, they studied the resources as they preferred and had the autonomy to move from one lesson content to another without following the prerequisites suggested. However, if the learners opted for the instructor-led routes, they were guided in an instructional manner with additional support from the lesson prerequisites. The lesson prerequisites, in this case, motivated the learners to build personal SRL skills while being led to study in a linear way.

Our results indicate and identify two distinct representations of the individual profiles of SRL from the analysed sample, namely, high self-regulators and low self-regulators as described in Chapter 6, subsections 6.3.4 and 6.3.5, and section 6.4. The results revealed that the competent self-regulators, as observed mostly within SDL, showed high levels of self-regulated strategies in their responses with few strategies to improve. However, for the low self-regulators, these learners needed to improve in their SRL strategies, as most of their responses fell into the negative scale. The results also indicated the individuality of the SRL dimensions observed from the learners, which revealed the different paths that most of the learners wished to follow in their study.

In summary, we define success not so much by the level of those who complete the course but by the learners who meet their expectations. Some issues of low completion rates in a MOOC might not be because the learners are not motivated to participate but because some of the learners are engaging with the course at their own pace. In this new innovative learning platform (known as eLDa), the completion rate was measured in relation to the learners achieving their learning goals.

9.2 Challenges and Limitations

The study does not conclude that the methods used by the students were successful with all modules or that they did help the students achieve better grades in others, as there was no further follow-up data to prove this. The only evidence that the study presented is the good performance observed from the weekly scores of assessments presented in this study from the blended-learning course. Another issue to mention was that the sample for this study was very small. On the plus side, this approach can be applied to a large-scale study, which could produce optimum results. The study observed initial hitches in the design phase, which were later resolved with the help of the new introduced components.

A general limitation of this thesis is represented by the restricted sample of participants that was used in both case studies, especially the small number of learners presented from the online standalone course. To allow for generalisation, the research model and framework should be tested on a wider scale, with learners of variable backgrounds, disciplines, and knowledge. The blended-learning limitation is seen in the availability of students to voluntarily complete and participate in the questionnaires. This issue occurred because the physical copies of the questionnaires were distributed at the end of the seminar class; therefore, the students after the seminar were rushing for another lecture, which might not allow them to fully concentrate to fill in the surveys accurately. Because of this, some of the questionnaires appeared to be incomplete and with blank responses in the comment column. It would be important to conduct the experiment more realistically, so that the students come solely to complete the questionnaires.

As with all self-reported data, the reliability of participants' answers may also be an issue. Ideally, triangulation using a different form of data collection or by asking the same question in different ways could be employed. However, in a 'real' course there is a need to balance the data collection activity so that it does not become burdensome (and perhaps less likely to elicit considered answers as a result). Further, it may not be reasonable to expect internal consistency between questions contributing to an SRL dimension. Learners well versed in SRL in a different context may display high levels on several aspects but may be unfamiliar with the need to exercise others. Finally, we note the diversity of learners' motivations. It may not be possible for MOOC providers to satisfy the wide range of expectations, particularly where these are not related to academic objectives. However, developing a greater understanding of what and how participants want to study and providing the means for them to achieve this can provide more flexibility in the MOOC format and offer a learning experience that is both better matched to needs and encourages self-regulation.

9.3 Recommendations for Future Work

This work indicates the need to support and develop SRL skills in MOOCs. The novel feature of allowing learners to set their own goals helps participants exercise and develop skills of self-determination. However, there are many other ways in which MOOCs could incorporate aspects of support. In line with a design science approach, future development of our platform will investigate ways of increasing and promoting social learning and the use of enhanced strategies to seek help. As well as building support into the platform, it is important to increase learners' self-awareness of their capabilities in these skills and their understanding of the importance of such skills for effective learning. Providing practical help for increasing their skill levels will provide learners with the tools to improve their SRL abilities and hence increase their effectiveness in establishing realistic learning objectives and pursuing them successfully.

Based on the findings, the researcher recommends that, before applying any instrument to measure the SRL skills of students in blended-learning concepts, the learning styles of the student should be investigated before developing or adapting the measuring instrument. This will help to obtain the exact reflection of the students' study patterns. This process of acquiring the profile and learning style of the students could be made possible with the advancement of good practice pedagogy, for example using adaptive concepts as part of the features in the course development. Therefore, an adaptive mechanism is recommended in creating MOOC course content to be able to capture the learning style of these students and to see how surveys could be conducted based on these learning styles and the event log captured during the registration. The researcher recommends that, before this can be done, it is essential to conduct a focus group interview to capture these learning behaviours of the students. This information could also help in the structure of the questions to be used in constructing measuring instruments for research.

Another important feature to recommend in this study is a recommender system. This system could provide a solution of suggesting suitable content to learners, as this approach could be compatible with the adaptive process. The application of adaptive and recommender systems will ease the learning experience of the learners. These concepts can be applied in recommender system algorithms for delivering personalised content based on learners' profiles, which can be stored during the registration. Thus, this would be appropriate in conjunction with a well-constructed curriculum model that might be worth investigating in the near future.

Nonetheless, this study recommended good pedagogical principles, as described with the eLDa learning tool. The tool focused on allowing learners to decide their route of study mode. It was designed in such a way that it suggests course prerequisites to aid the full understanding of the course content during the study. This helps in supporting online learners and students in the blended-learning environment to decide their path in the course using the visualisation of course curriculum.

This study also provides guidance for instructional course developers to understand or consider best practices in creating an efficient e-learning system. The current research has gathered data from only a small number of MOOC participants, but from this, themes of interest have emerged for further investigation. The future research work will extend the trial by gathering data from a new and different course perspective. This will allow us not only to extend the data relating to SRL among MOOC participants but to compare SRL skills, development, and attainment between MOOCs used in a fully online mode and those used for blended-learning in conjunction with classroom teaching. Further, we will investigate additional ways in which user data can be harnessed to support SRL. For example, test scores may indicate weaknesses in certain areas, allowing targeted feedback and personalised suggestions of appropriate remedial learning materials to be offered.

This future research work aims to investigate new theories of self-regulation of learning to acquire the evolving knowledge and strategies of the learners in MOOCs and in blended-learning environments. Future research will continue to investigate and evaluate in full the six SRL dimensions and explore whether similar patterns of learning might be observed among the participants. The perceptions of SRL will be further explored using the six dimensions investigated in this study. We also propose an additional measurement instrument to be developed and tested in the future for assessing the different perspectives of SDL and SRL. Further studies could explore possibilities of new methodologies that could open new perspectives for understanding SDL and SRL. To support these investigations, a further advancement will be done with the existing tool (eLDa) that was used in this study. Implications for further theory and the development of learning environments that provide adaptive support will be incorporated. The adaptive components and recommender functionalities are being considered to foster this proposed future research interest.

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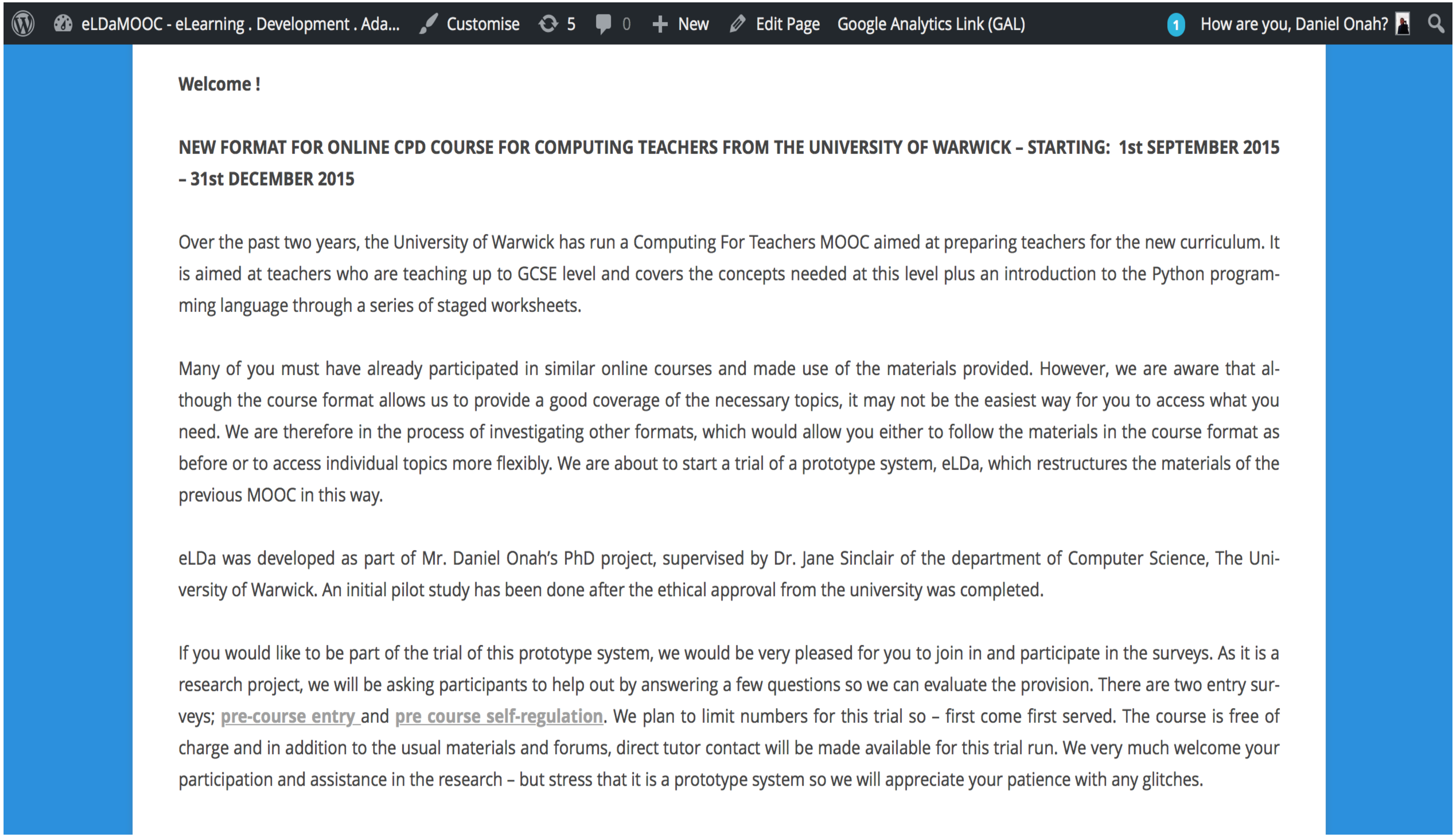
Appendix A

Research Consent Forms

This Appendix section presents the consent forms for both case studies. Figures A.1 and A.2 presents an online consent form embedded in the standalone platform. Figures A.3, A.4 and A.5 presents the consent forms for the blended-learning case study.



Welcome !

NEW FORMAT FOR ONLINE CPD COURSE FOR COMPUTING TEACHERS FROM THE UNIVERSITY OF WARWICK – STARTING: 1st SEPTEMBER 2015 – 31st DECEMBER 2015

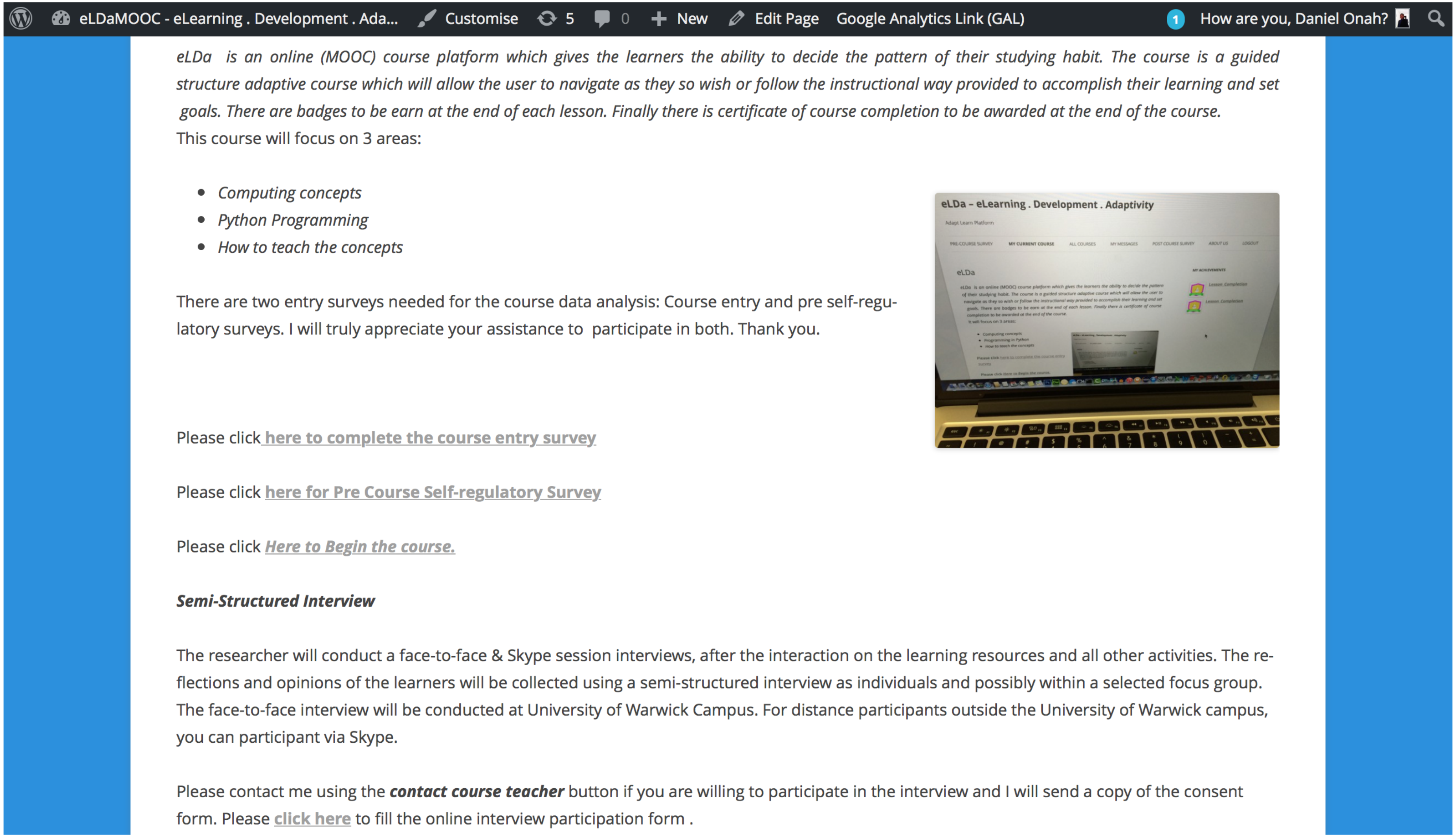
Over the past two years, the University of Warwick has run a Computing For Teachers MOOC aimed at preparing teachers for the new curriculum. It is aimed at teachers who are teaching up to GCSE level and covers the concepts needed at this level plus an introduction to the Python programming language through a series of staged worksheets.

Many of you must have already participated in similar online courses and made use of the materials provided. However, we are aware that although the course format allows us to provide a good coverage of the necessary topics, it may not be the easiest way for you to access what you need. We are therefore in the process of investigating other formats, which would allow you either to follow the materials in the course format as before or to access individual topics more flexibly. We are about to start a trial of a prototype system, eLDa, which restructures the materials of the previous MOOC in this way.

eLDa was developed as part of Mr. Daniel Onah's PhD project, supervised by Dr. Jane Sinclair of the department of Computer Science, The University of Warwick. An initial pilot study has been done after the ethical approval from the university was completed.

If you would like to be part of the trial of this prototype system, we would be very pleased for you to join in and participate in the surveys. As it is a research project, we will be asking participants to help out by answering a few questions so we can evaluate the provision. There are two entry surveys; pre-course entry and pre course self-regulation. We plan to limit numbers for this trial so – first come first served. The course is free of charge and in addition to the usual materials and forums, direct tutor contact will be made available for this trial run. We very much welcome your participation and assistance in the research – but stress that it is a prototype system so we will appreciate your patience with any glitches.

Figure A.1: Online stand-alone course consent 1.



eLDaMOOC - eLearning . Development . Ada... Customise 5 0 New Edit Page Google Analytics Link (GAL) How are you, Daniel Onah?

eLDa is an online (MOOC) course platform which gives the learners the ability to decide the pattern of their studying habit. The course is a guided structure adaptive course which will allow the user to navigate as they so wish or follow the instructional way provided to accomplish their learning and set goals. There are badges to be earn at the end of each lesson. Finally there is certificate of course completion to be awarded at the end of the course.

This course will focus on 3 areas:

- *Computing concepts*
- *Python Programming*
- *How to teach the concepts*

There are two entry surveys needed for the course data analysis: Course entry and pre self-regulatory surveys. I will truly appreciate your assistance to participate in both. Thank you.

Please click here to complete the course entry survey

Please click here for Pre Course Self-regulatory Survey

Please click *Here to Begin the course.*

Semi-Structured Interview

The researcher will conduct a face-to-face & Skype session interviews, after the interaction on the learning resources and all other activities. The reflections and opinions of the learners will be collected using a semi-structured interview as individuals and possibly within a selected focus group. The face-to-face interview will be conducted at University of Warwick Campus. For distance participants outside the University of Warwick campus, you can participant via Skype.

Please contact me using the ***contact course teacher*** button if you are willing to participate in the interview and I will send a copy of the consent form. Please click here to fill the online interview participation form .

Figure A.2: Online stand-alone course consent 2.

Consent for Participation in Research Focus Group Interview
Department of Computer Science, The University of Warwick, Coventry, UK

Project Title

EXPLORING USER CHOICE AND SELF-REGULATED LEARNING IN A NOVEL E-LEARNING PLATFORM (eLDa)

Researcher Details

Daniel F.O. Onah
CS327 Intelligent & Adaptive Systems
Department of Computer Science
The University of Warwick
Coventry
CV4 7AL
Tel: *+44(0) 2476573801*

Brief Description of Project

eLDa is an online MOOC platform, which gives the learners the ability to decide the pattern of their studying habit and observing participant inform choice in a self-regulatory study. The course comprises guided structured learning materials in a novel platform, which allows the user to navigate as they so wish or follow the instructional way provided to accomplish their learning and set goals. The course however, has three strands: computing concepts, Python programming, and how to teach computing curriculum.

The study introduced a blended classroom seminar for first year undergraduate computer science students. The research will monitor the participants' understanding of the learning structure suggested to them. I will be investigating how the concepts and lessons were engaged with, are participants willing to follow the instructional routes suggested to them by the system or they decide otherwise. Experimental research will be conducted in comparison of the two modes within the learning platform, which will be evaluated concurrently based on the responses from the participants. Finally I will observe to what extend the courses in both modes in the eLDa platform helps in improving self-regulated study habits amongst participants.

Figure A.3: Focus group consent form page 1.

Interview

Semi-Structured Interview

The researcher will conduct a face-to-face session interviews, after the interaction on the learning resources and all other activities. The reflections and opinions of the learners will be collected using a semi-structured interview as individuals or possibly within a selected focus group.

Data from research

Data to be collected and processed

You have been asked for your consent to take part in an individual or focus group interview regarding a novel online learning platform called 'eLDa'. The semi-structured interview will seek to gather your personal experiences and opinions. Interviews will be recorded and later a transcription into a text will be done. The researcher will be applying a non-invasive technique in conducting the interview.

Consent

1. I have read and understood the information sheet for the above Project and have had the opportunity to ask questions. ☐
2. I understand my participation is voluntary and that I have the right to withdraw at any time without giving reasons and without any of my rights being affected. ☐
3. I understand that confidentiality will be maintained at all times, that I will not be identified and that my data will be anonymised, unless otherwise explicitly stated. ☐
4. I understand that only the research team will access the data. Information will be stored in a secure place and destroyed on completion of the research project. ☐
5. I agree to take part in this study ☐

....	....	....
Name of participant	Signature	Date
....	....	....
Name of researcher	Signature	Date

Figure A.4: Focus group consent form page 2.

Contact details for withdrawal

Daniel F. O. Onah
Department of Computer Science
The University of Warwick
Coventry
CV4 7AL
Email: d.f.o.onah@warwick.ac.uk

Dr. Jane E. Sinclair
Department of Computer Science
The University of Warwick
Coventry
CV4 7AL
Email: j.e.sinclair@warwick.ac.uk

Who should I contact if I wish to make a complaint?
Any complaint about the way you have been dealt with during the study or any possible harm you might have suffered will be addressed. Please address your complaint to the person below, who is a senior University of Warwick official entirely independent of this study:
Director of Delivery Assurance
Registrar's Office
University House
University of Warwick
Coventry
CV4 8UW
Complaints@Warwick.ac.uk
024 7657 4774

Figure A.5: Focus group consent form page 3.

Appendix B

Online Pilot Course Survey

Table B.1 shows the pre-entry course survey questions used in the pilot study that informed further improvement of the eLDa platform design.

Table B.1: Pre-entry course survey.

	Survey questions
1	What is your gender?
2	What is your age?
3	What is your highest level of education?
4	Have you had any experience in Python programming?
5	Have you had any experience in computing concepts?
6	What are your expectations?
7	What motivates you to take this course?
8	What kind of courses do you prefer?
9	How did you hear about this course?
10	How long do you intend to spend in this course?
11	How much of time do you intend to spend a day in this course?
12	How long do you intend to spend on this course?
13	Do you prefer short courses to long courses?
14	Do you prefer watching short lecture videos to long lecture videos?
15	What kind of online course delivery do you prefer?

Appendix C

MOSLQ Instrument

Goal setting

	Strongly agree	Agree	Neutral	disagree	Strongly disagree
GSQ1 : I know what I am going to achieve in this course	○	○	○	○	○
GSQ2 : I have set aside time to study the course	○	○	○	○	○
GSQ3 : I have high standards for my work in this course	○	○	○	○	○
GSQ4 : I have set targets for all I want to achieve in this course	○	○	○	○	○
GSQ5 : I do not see my engagement in the course as less important solely because it is an online course	○	○	○	○	○
GSQ6 : I have written down the goals I plan to achieve by the end of this course	○	○	○	○	○

Figure C.1: Goal setting dimension.

Task strategies

	Strongly agree	Agree	Neutral	disagree	Strongly disagree
TSQ7 : I work strategically to prioritise tasks to help me achieve my learning goals	○	○	○	○	○
TSQ8 : I prepare for my online study by reading the suggested background learning materials beforehand	○	○	○	○	○
TSQ9 : I set out my study agenda before engaging with the online resources	○	○	○	○	○
TSQ10 : I am prepared to tackle any challenging aspects of the work in this course	○	○	○	○	○

Figure C.2: Task strategies dimension.

Time Management

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
TMQ11 : I have planned ahead in order to devote the necessary time to my online studies	○	○	○	○	○
TMQ12 : I find a good time to study when I won't be distracted	○	○	○	○	○

Figure C.3: Time management dimension.

Environment structuring

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
ESQ13 : I choose my study location in order to avoid distractions					
ESQ14 : I find a comfortable place to study					
ESQ15 : I choose an appropriate place to work in order to study effectively					

Figure C.4: Environment structuring dimension.

Help seeking

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
HSQ16 : I plan to use the interactive communication channels provided to gain support from peers and tutors					
HSQ17 : I plan to participate in the course discussion forums in order to get the most out of the course					

Figure C.5: Help seeking dimension.

Self-evaluation

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
SEQ18 : While engaging in this course, I will reflect on my study in each module	○	○	○	○	○
SEQ19 : I will be proactive in engaging and reviewing progress in the learning path I select	○	○	○	○	○

Figure C.6: Self-evaluation dimension.

Appendix D

In-Course Surveys

Pre-Course Survey

1. * What is your gender?

○ Male

○ Female

○ Prefer not to say

2. * What is your age?

○ under 18

○ 18-24

○ 25-34

○ 35-44

○ 45-54

○ 55 or over

3. * What is your highest level of education?

○ Undergraduate

○ Graduate

○ Others

4. * Have you had any experience in Python programming?

○ Yes

○ No

5. * Have you had any experience in Computing concepts

○ Yes

○ No

6. What are your expectations? (please tick all that apply)

□ Learn new ideas

□ Observe online education and MOOCs

□ To acquire a certificate

□ Learn more of Python programming

□ Make new friends

□ Learn more about computing

□ unsure out of curiosity

7. What motivates you to take this course?(Please select all that applies)

□ To learn new skills

□ Out of curiosity

□ Interested in the course

□ Learn computing and programming

8. What kind of courses do you prefer?

○ Long courses

○ Short courses

9. How did you hear about this course? (Please click all that applies)

□ Google search engine

□ Word of mouth from friend

☐ From the course author and developer

☐ Other online resources

10. How long do you intend to spend in this course?

○ Days

○ Weeks

○ Months

○ Till the End

11. How much of time do you intend to spend a day in this course?

○ Less than an hour

○ 1 hour

○ 2 hours

○ More than 2 hours

12. How long do you intend to spend on this course?

○ More than five days

○ More than two weeks

○ More than two months

○ Till the end of the course

13. Do you prefer short courses to long courses?

○ Yes

○ No

14. Do you prefer watching short lecture videos to long lecture videos?

○ Yes

○ No

15. What kind of online course delivery do you prefer? (Please select all that applies)

☐ Interactive learning

☐ Collaborative learning

☐ Self-mode learning

☐ Instructor-led guided learning

Session 0 Survey

1. Do you have any prior knowledge of Python programming?

○ Yes

○ No

2. Do you have any knowledge of computing concepts?

○ Yes

○ No

3. What did you prefer in a MOOC learning system? (Please tick all that applies)

☐ Interaction and collaboration

☐ Concise

☐ Guided lesson

☐ Self-pace learning

4. The interactive components used in this module were greatly useful.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

5. The use of private communication was effective to enhance learning.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

6. The quizzes were of great value to understanding the concepts.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

7. Which of the interactive components did you prefer or enjoy using?

□ Comment box

□ Private messaging

□ Badges

□ Quizzes

□ Lesson prerequisites

8. The idea of certificate at the end of the module was brilliant

○ Yes

○ No

Session 1 Survey

1. The concepts taught were very useful.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

2. what components do you enjoyed in this module?

□ The structure of the course

□ Videos

□ Slides

□ Transcripts

3. In your opinion how much time did you spend a day in this course?

○ Less than 30 minutes

○ 1 hour

○ 2 hours

○ More than 3 hours

4. Do you have any prior knowledge of the concepts described here?

○ Yes

○ No

5. Do you understand the guided structure you were led in this course?

○ Yes

○ No

6. How do you feel about the importance of the quiz questions to the concepts discussed?

○ Very interesting

○ Interesting

○ Satisfactory

○ Less satisfactory

7. How many hours did you spend in this module?

○ less than 30 minutes

○ 1 hour

○ 2 hours

○ more than 2 hours

8. Which do you prefer?

○ Long videos

○ Short videos

9. Which of the components did you engage with? (Please select all that applies).

☐ Messages

☐ Comments

☐ Badges

☐ Certificates

☐ Quizzes

☐ Lab exercise and solutions

10. In scale of 1 - 5, how will you rate this session module?

○ 5

○ 4

○ 3

○ 2

○ 1

11. Which of the following components did you find fascinating?(Please select all that applies).

☐ Messages

☐ Comments

☐ Badges

☐ Certificates

☐ Quizzes

☐ Lab Practical exercises

☐ Lab Solutions

12. Do you enjoy watching lengthy lecture videos?

○ Yes

○ No

Session 2 Survey

1. What did you enjoyed about eLDa learning platform?(Please select all that applies)

☐ Interaction and collaboration

☐ Concise lecture resources

☐ Guided lesson structure

☐ Self-pace learning mode

☐ User friendly

2. Which of the interactive components did you less prefer?

☐ Comment

☐ Quiz

☐ Private messaging

☐ Concepts recommendation

☐ Lesson prerequisites

☐ They are all useful

3. Which of the interactive components were very useful?(Please select all that applies)

☐ Comments

☐ Private messaging

☐ Badges

☐ Quizzes

☐ Lesson prerequisites

☐ Concepts recommendation

☐ Self-mode navigation

4. On a scale of 1 - 5 , how will you rate this session module?

○ 5

○ 4

○ 3

○ 2

○ 1

5. I found private messaging very useful.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

6. I found the concepts of giving comments in a lesson informative.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

7. Quizzes are great interactive tools in the course.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

Session 3 Survey

1. Does earning badges act as a motivating factor toward your participation?

○ Yes

○ No

2. On average, how useful do you think the interactive components in the module were?

○ Less than 30

○ 50

○ 80

○ Above 80

3. How easy is it to navigate around the modules?

○ Very easy

○ Slightly easy

○ Difficult

○ Very difficult

4. The modules and the components are user friendly.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

5. Earning badges encourages more user enthusiasm to continue in the modules.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

6. On a scale of 1 - 5, how will you rate this chapter 4 module?

○ 5

○ 4

○ 3

○ 2

○ 1

Session 4 Survey

1. Private messaging is a component in eLDa system for learners to interact with the tutor and discuss areas of concern. How important is this to you?

○ Very important

○ Important

○ Less important

2. Comment box is introduced for discussion and exchange of ideas among learners. How useful is this to you?

○ Very useful

○ Useful

○ Less useful

3. In your opinion how much time do you spend in a day on a module?

○ Less than 30 minutes

○ 1 hour

○ 2 hours

○ More than 2 hours

4. The concepts delivered on the course were very useful to my understanding and support.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

5. On a scale of 1 - 5, how will you rate this session of chapter 5 module?

○ 5

○ 4

○ 3

○ 2

○ 1

Session 5 Survey

1. Which of these pathways navigation do you prefer?

○ Guided structure

○ Self-directed

○ Both guided and self-directed mode

2. On a scale of 1 - 5, how will you rate this chapter 6 module?

○ 5

○ 4

○ 3

○ 2

○ 1

3. I prefer to study in a self-study mode.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

4. I prefer to be guided in the course by the instructor.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

5. The interactive lesson reset button was very useful.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

6. The interactive lesson completion progress level was very important.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

Session 6 Survey

1. On a scale of 1 - 5, how will you rate this chapter 7 module?

○ 5

○ 4

○ 3

○ 2

○ 1

2. I found the lesson prerequisites very useful.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

3. I found the content recommendation supportive to learning.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

4. The comment box was very important in aiding lesson supports.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

5. The contact course teacher component was great.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

Post Course Survey

1. Did you meet most of your set goals before enrolment?

○ Yes

○ No

○ Somewhat

2. What are the components that were most useful in supporting your full participation in these course? (Please tick all that applies)

☐ Quizzes

☐ Badges

☐ Comment box

☐ Private messaging

☐ Certificate

☐ Lesson prerequisite

☐ Content recommendation

3. I was better informed about computing concepts after the course.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

4. I acquired some knowledge about Python programming at the end of the course.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

5. I have better understanding on algorithms after the course.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

6. The interactive components in each lesson were very helpful.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

7. The private messaging in the lesson was very helpful to contact the tutor for support.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

8. The idea of obtaining a certificate at the end of the course was brilliant.

○ Strongly agree

○ Agree

○ Neutral

○ Disagree

○ Strongly disagree

9. What did you find most useful in eLDa system? (Please select all that applies)

□ Interactive content

□ Collaborating with peers by way of comment

□ Concise lecture resources

□ Guided instructor led lesson structure

□ Allowing self-pace learning mode

Appendix E

Pre-Seminar Survey

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SEMINAR SURVEY: CS140 COMPUTER SECURITY
DEPARTMENT OF COMPUTER SCIENCE, THE UNIVERSITY OF WARWICK
COVENTRY, CV4 7AL
Tutor: DANIEL ONAH (Doctoral Researcher)

The main purpose of this brief anonymous evaluation is to gather information on how the blended course introduced has supported you in your studies. I wish to acquire some views on my teaching strategies, together with constructive suggestions for further improvement in my teaching methods and skills.

Please tick a box to indicate the level to which you agree or disagree with the following statements.

Seminar Title: CS140 Computer Security	Date: Friday 4th DECEMBER 2015

1. Have you ever participated in a blended classroom learning before?

Yes ☐
No ☐

If **Yes** please specify the name(s):

2. The blended classroom content was appropriate for my understanding.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

3. I found the teaching method using seminars appropriate to enhance my self-study skills.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

4. The interactive group learning exercises were beneficial to me.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

5. I found the group intervention and contribution by the tutor very useful to clarify my concerns.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

Figure E.1: Pre- seminar questionnaire 1.

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6. I found the group discussions and presentations by representatives from groups very useful.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

7. I do prepare on my own to engage with the blended online course.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

8. I found the tutor engagement with the group discussion helpful to clarify doubts and issues.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

9. The blended classroom seminars were of high quality and informative.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

10. The online blended course content helps me in preparing for my class lectures.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

11. I found the seminars and the various methods of delivery satisfactory.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

Figure E.2: Pre- seminar questionnaire 2.

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12. In general, the quality of teaching and methods used during the seminars were good.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

13. I understand the course further after going through the online blended content.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

14. The suggested reading material helps me to read further.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

15. I was able to write a better academic reference from the hints on the online blended class.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

15. The blended class teaching helps in improving my learning skills.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

17. The lecture and the online blended classroom content fit properly in broaden my understanding of the course.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

Figure E.3: Pre- seminar questionnaire 3.

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18. The blended online class teaching and the content was very helpful.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

19. The discussion forum in the blended classroom was supportive in increasing my self-study skills.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

20. I planned my questions before asking in the online blended classroom and in the seminar.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

21. The lecture videos, slides and external links were helpful in enhancing my further reading.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

22. I am motivated to study more with the assistance of the blended classroom weekly seminar lecture.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

23. I am enthusiastic to study more following the online blended classroom content provided.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

Figure E.4: Pre- seminar questionnaire 4.

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24. The online blended seminar class have helped me to build my own self-choice of learning.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

25. The course and the blended online content help me to study better.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

26. I improve my assessment grades due to the online blended classroom and seminar lectures.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

27. The blended online classroom was well integrated with the weekly seminar classes.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

28. The blended class help me to prepare towards the next seminars.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

29. How would you rate your experience in this online blended seminar classes?

Very High	High	Average	Low	Very Low
☐	☐	☐	☐	☐

Any comments?:

Figure E.5: Pre- seminar questionnaire 5.

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30. What did you find most useful in the blended class seminars?

31. What did you find least important in the blended class seminars?

32. Were there any areas you would have like more coverage and to be addressed during the blended class seminars?

33. What did you find interesting during the interactive group discussion?

34. What useful comments do you have for the pattern of the blended learning seminars delivery?

35. How do you feel about the blended classroom introduced in the seminar, was it useful to support your reading habits?

36. What further improvements do you wish to be included in the blended methods of delivery?

37. Overall how has the blended class seminar help you academically in your choice of studies?

Figure E.6: Pre- seminar questionnaire 6.

Appendix F

Post Seminar SRL Survey

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POST SEMINAR SURVEY: CS140 COMPUTER SECURITY
DEPARTMENT OF COMPUTER SCIENCE, THE UNIVERSITY OF WARWICK
COVENTRY, CV4 7AL
Tutor: DANIEL ONAH (Doctoral Researcher)

The main purpose of this brief anonymous evaluation is to gather information on how the blended course introduced has supported you in your studies. I wish to acquire some views on your achievement and improvement of your skills. In addition, I would appreciate some constructive feedback for further improvement in these teaching methods and skills.

Please tick a box to indicate the level to which you agree or disagree with the following statements.

Seminar Title: CS140 Computer Security	Date: Friday 10th DECEMBER 2015

Goal Setting and Learning Environment

1. I set goals to help me manage studying time for my blended classroom lecture seminar.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

2. I don't compromise the quality of my contribution because it is a blended class seminar.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

3. I set reasonable goals to achieve during this semester's blended classroom teaching.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

4. I set standards for my weekly assignment after the blended class.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

Figure F.1: Post seminar SRL questionnaire 1.

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5. I keep a high standard for my studying in the blended online classroom seminar.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

6. I choose my preferable environment to study in order to avoid any distraction.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

7. I decide on a comfortable place to do my studying.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

8. I know the proper location where I can study efficiently for my online blended seminar course.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

9. I choose a certain period with less noise for my blended learning.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

Figure F.2: Post seminar SRL questionnaire 2.

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Assignment and Time Management

10. I read aloud while engaging with the instructional material in this blended class to avoid distractions.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

11. I prepare my questions before contributing in this blended class or any online discussion.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

12. I find the solutions to problems in the blended class or any online courses aided me to master the content.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

13. I try to take in more notes during the blended classroom seminar to improve my ability to study.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

14. I allocate sometime to my online blended classroom seminar to acquire more knowledge.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

Figure F.3: Post seminar SRL questionnaire 3.

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15. I try to schedule some time every week to prepare for my online blended classroom seminar.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

16. I allocate some time every week to engage with the blended classroom extra course resources.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

17. I distribute my study time evenly between my courses and some time to the blended online seminar classes.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

18. I studied the blended content before coming to the seminar class.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

19. I engage with the blended classroom after each week's seminar to gain more understanding of the lesson.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

Figure F.4: Post seminar SRL questionnaire 4.

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Critical Thinking and Analytical Skills

20. I find a colleague who is knowledgeable in the course content so I ask him or her when I need any help.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

21. I share my problems with my colleagues online to discuss and find a solution.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

22. Sometimes I meet my classmate one-on-one to discuss exercises and assignments.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

23. I am persistent in getting help from the seminar tutor though email.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

24. I summarize my blended classroom learning to examine my understanding of what I have learnt.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

Figure F.5: Post seminar SRL questionnaire 5.

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25. I ask myself a lot of questions about the online resources while studying for the blended classroom seminar.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

26. I communicate with my classmates to find out if I understood the online blended seminar course.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

27. I discuss with my classmates to see whether what I understood during the blended classroom is what they understand as well.

Strongly Agree	Agree	Neither Agree nor Disagree	Disagree	Strongly Disagree
☐	☐	☐	☐	☐

Any comments?:

Self-Regulatory and Personal enhancement Skills Acquired From the Blended Seminar

28. Were you able to improve your learning skills during this blended classroom seminar?

29. How were your time management skills after this blended classroom?

30. Have you been able to learn a better approach to answer assignment questions during the blended classroom seminar?

31. Have you developed the skills/ability of solving and responding to any issue raised in regards to the seminar topics and content in a real-life/world scenario?

Figure F.6: Post seminar SRL questionnaire 6.

Appendix G

Focus Group Interview Questions

Date: 8$^{\text{th}}$ February 2016 and 9$^{\text{th}}$ February 2016

Goal Setting

1. Could you tell me how you have prepare for your studies?
2. Could you tell me how you organise your set goals to help you manage your study time?
3. Could you tell me how do your prioritise your learning and reading patterns?
4. Could you tell me what motivates you to study in a self-directed manner?(Using your own choice of learning)

Task Strategies

5. Could you tell me what strategies you used in engaging with your studies?
6. Tell me how do you influence your study decision on a daily basis? For example, if your plans for the day was affected.
7. What is your best approach in tackling your assessment task?
8. How much effort do you placed in making sure your task is well presented? Tell me how this was done?
9. In your opinion, which strategy do you think is the best practice for your learning? Please give your reasons for chosen it.

Time Management

10. What influences your decision in allocating the time for your study? Could you share with me how you decide the various times?
11. Could tell me what strategies do you apply in allocating much time to modules with heavy credit units?
12. What principles of learning did you apply to maintain steady reading culture and time across your studies?
13. Could you tell me what method did you use to create your reading timetable? Please discuss what are your considerations.
14. What practice of learning do you use to be consistent with your schedule reading routine? Tell me what you did to make up for loose hours.
15. Could you explain how you distribute your study period evenly across your Modules? Tell me how this was done.

Environment Structuring

16. How do you feel when you chose an environment to study? Can you discuss your preferred learning environment?
17. In what ways has your preferred learning environment helped your studies?
18. In what ways has your chosen location of study help contributed to achieving your learning goals?
19. What do you hope to gain by chosen a comfortable place to study?

Help Seeking

20. In what ways do you seek for help with your studies? Please tell me how you have done this.

Self-evaluation

21. Could you tell me what approach do you apply in revising your learning resources?
22. Could you tell me in what ways have you reflected on your studies? On what occasion have you done this and why?
23. What drives you to study the way you are studying now? And why?

24. How do you evaluate your choice of study? What influences your decisions? Could you tell me what shows that you have improved in your studies?
25. Could you share with me in what circumstance have you reflected in a group study? How has this helped your study?

Questions on Blended Classroom Seminar

26. Have you participated in an online blended classroom seminar prior to this?
27. What do you think of the approach used in the blended class?
28. Do you think this method of learning was much different to your usual seminars and in what ways?
29. Does this approach lead you to study in a different way and if so, describe in what ways.
30. How do you prefer to study? Explain to me if you wish to be guided in an instructional way or if you prefer self-study mode.
31. Explain to me in what ways has the blended seminar class supported your study.
32. Could you tell me in what ways has the online learning resource help you during your further reading.
33. Could you tell me how the weekly delivery of learning content during the blended class has supported your learning patterns.
34. How have you improved in your self-study skills? Explain the self-study skills you think you have acquired?
35. Could you tell me in what ways has the blended class seminar help you to reflect on your learning?
36. Has the blended seminar course help you to re-consider a new way of learning? What can you say inform your thoughts?

Appendix H

Research Ethical Approval

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17/08/15

PRIVATE

Dear Daniel Friday Owoichoche Onah,

Exploring User Choice And Self-Regulated Learning In A Novel Elearning Platform (eLDa)

REGO-2015-1635 Onah

Thank you for submitting the above-named project to the University of Warwick Biomedical and Scientific Research Ethics Committee for research ethical review.

I am pleased to advise that research ethical approval is granted.

You must, however, insert the following into the information given to participants:

> **Who should I contact if I wish to make a complaint?**
> Any complaint about the way you have been dealt with during the study or any possible harm you might have suffered will be addressed. Please address your complaint to the person below, who is a senior University of Warwick official entirely independent of this study:
>
> **Director of Delivery Assurance**
> Registrar's Office
> University House
> University of Warwick
> Coventry
> CV4 8UW
> Complaints@Warwick.ac.uk
> 024 7657 4774

In undertaking your study, you are required to comply with the University of Warwick's *Research Data Management Policy*, details of which may be found on the Research and Impact Services' webpages, under "Codes of Practice & Policies" » "Research Code of

Figure H.1: Research ethical approval page 1.

Practice" » "Data & Records" » "Research Data Management Policy", at:
http://www2.warwick.ac.uk/services/ris/research_integrity/code_of_practice_and_policies/research_code_of_practice/datacollection_retention/research_data_mgt_policy

You are also required to comply with the University of Warwick's *Information Classification and Handling Procedure*, details of which may be found on the University's Governance webpages, under "Governance" » "Information Security" » "Information Classification and Handling Procedure", at: http://www2.warwick.ac.uk/services/gov/informationsecurity/handling. Investigators should familiarise themselves with the classifications of information defined therein, and the requirements for the storage and transportation of information within the different classifications:

> *Information Classifications:*
> http://www2.warwick.ac.uk/services/gov/informationsecurity/handling/classifications
> *Handling Electronic Information:*
> http://www2.warwick.ac.uk/services/gov/informationsecurity/handling/electronic/
> *Handling Paper or other media*
> http://www2.warwick.ac.uk/services/gov/informationsecurity/handling/paper/.

Please also be aware that BSREC grants **ethical approval** for studies. **The seeking and obtaining of *all* other necessary approvals is the responsibility of the investigator.** These other approvals may include, but are not limited to:

1. Any necessary agreements, approvals, or permissions required in order to comply with the University of Warwick's Financial Regulations and Procedures.
2. Any necessary approval or permission required in order to comply with the University of Warwick's Quality Management System and Standard Operating Procedures for the governance, acquisition, storage, use, and disposal of human samples for research.
3. All relevant University, Faculty, and Divisional/Departmental approvals, if an employee or student of the University of Warwick.
4. Approval from the applicant's academic supervisor and course/module leader (as appropriate), if a student of the University of Warwick.
5. NHS Trust R&D Management Approval, for research studies undertaken in NHS Trusts.
6. NHS Trust Clinical Audit Approval, for clinical audit studies undertaken in NHS Trusts.
7. Approval from Departmental or Divisional Heads, as required under local procedures, within Health and Social Care organisations hosting the study.
8. Local ethical approval for studies undertaken overseas, or in other HE institutions in the UK.
9. Approval from Heads (or delegates thereof) of UK Medical Schools, for studies involving medical students as participants.
10. Permission from Warwick Medical School to access medical students or medical student data for research or evaluation purposes.
11. NHS Trust Caldicott Guardian Approval, for studies where identifiable data is being transferred outside of the direct clinical care team. Individual NHS Trust procedures vary in their implementation of Caldicott guidance, and local guidance must be sought.
12. Any other approval required by the institution hosting the study, or by the applicant's employer.

There is no requirement to supply documentary evidence of any of the above to BSREC, but applicants should hold such evidence in their Study Master File for University of Warwick auditing and monitoring purposes. You may be required to supply evidence of any necessary approvals to other University functions, e.g. The Finance Office, Research & Impact Services (RIS), or your Department/School.

Figure H.2: Research ethical approval page 2.

May I take this opportunity to wish you success with your study, and to remind you that any Substantial Amendments to your study require approval from BSREC before they may be implemented.

Yours sincerely

pp Graham Hewitt

Professor Scott Weich
Chair
Biomedical and Scientific
Research Ethics Sub-Committee

Biomedical and Scientific
Research Ethics Sub-Committee
A010 Medical School Building
Warwick Medical School,
Coventry, CV4 7AL.
Tel: 02476-528207
Email: BSREC@Warwick.ac.uk

Figure H.3: Research ethical approval page 3.